



HEWLETT  
PACKARD

OPERATING INFORMATION

**5344S**  
**Microwave Source Synchronizer**

**SERIAL PREFIX: 2314A**

This manual applies to Serial Prefix 2314A, unless accompanied by a Manual Change Sheet indicating otherwise.

©Copyright      HEWLETT-PACKARD COMPANY      1983  
5301 STEVENS CREEK BOULEVARD, SANTA CLARA, CA 95050



```

* * * * * MANUAL IDENTIFICATION * * * * *
*
* * * * * MANUAL UPDATING COVERAGE * * * * *
*
* This supplement adapts your manual
* to instruments with serial numbers
* prefixed through 2438.
*
* * * * *
*
* Instrument:      HP 5344S
*                  Microwave Source
*                  Synthesizer
*                  Operating Information
*                  Manual
* Manual Part No:  05344-90011
* Manual Microfiche: -
* Manual Print Date: Sept 1983
* * * * *

```

### ABOUT THIS SUPPLEMENT

The information in this supplement is provided to correct manual errors and to update the manual to instruments containing changes after the manual print date.

Change and correction information in this supplement is itemized by page numbers corresponding to the original manual pages. The pages in this supplement are organized in numerical order by manual page number.

Manual updating supplements are revised as often as necessary to keep manuals as accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the model number, print date, and part number listed at the top of this page.

### HOW TO USE THIS SUPPLEMENT

Insert this title page in front of the title page in your manual.

Perform all changes specified for "All Serials", and all changes through the Series Prefix of your instrument or board.

Insert any complete replacement pages provided into your manual in the proper location.

If your manual has been updated according to the last edition of this supplement, you need only perform those changes pertaining to the new series prefix. See List of Effective Pages on the reverse side of this page. New information affecting "All Serials" will be indicated by a "#" in front of the page number.

# LIST OF EFFECTIVE PAGES

```
*****
*   SERIAL PREFIX OR                                     *
*   SERIAL NUMBER           PAGES                       *
*****
```

All Serials

Cover Spine

2314 thru 2438

These changes do not affect the Operating  
Information Manual.

## MANUAL CHANGES MODEL 5344S (05344-90011)

```
-----
SERIAL PREFIX OR
SERIES NUMBER
```

```
CHANGES
-----
```

### Cover Spine

All Serials

>Change spine to read "Operating Information Manual".

```
-----
(5344A0)2314=14862,15882/2415=16260/2438=16334
```

## TABLE OF CONTENTS

Section	Title	Page
<b>I</b>	<b>GENERAL INFORMATION</b>	<b>1-1</b>
	1-1. Introduction	1-1
	1-4. Instruments Covered by Manual	1-1
	1-7. Operating Manual	1-1
	1-9. Specifications	1-1
	1-12. Safety Considerations	1-5
	1-14. Equipment Supplied	1-5
	1-16. Equipment Available	1-5
	1-18. Description	1-5
	1-20. Model Numbers	1-6
	1-22. Options	1-6
	1-24. Ordering Special 5344S Combinations	1-7
	1-28. Operation of Counter Options with the 5344A	1-7
	1-31. Recommended Test Equipment	1-8
<b>II</b>	<b>INSTALLATION</b>	<b>2-1</b>
	2-1. Introduction	2-1
	2-3. Unpacking and Inspection	2-1
	2-5. Preparations for Use	2-1
	2-6. Power Requirements	2-1
	2-8. Line Voltage Selection	2-1
	2-14. Power Cable	2-2
	2-16. Operating Environment	2-4
	2-19. Mating Counter to 5344A	2-4
	2-21. Compatibility with 5342A/43A Counters	2-5
	2-23. Required Modifications for Earlier Version 5342A/43A Counters	2-5
	2-25. HP-IB Interconnections	2-7
	2-28. 5344A Listen/Talk Address	2-7
	2-30. HP-IB Descriptions	2-7
	2-32. Operational Check	2-9
	2-34. Packaging for Reshipment	2-9
	2-35. Original Packaging	2-9
	2-40. Other Packaging Methods	2-9
	2-42. Storage	2-9
<b>III</b>	<b>OPERATION AND PROGRAMMING</b>	<b>3-1</b>
	3-1. Introduction	3-1
	3-8. Modes of Operation	3-1
	3-10. Manual Lock Modes	3-1
	3-12. CW in Manual Lock	3-2
	3-14. CF/ $\Delta$ F in Manual Lock	3-2
	3-17. Start/Stop in Manual Lock	3-2
	3-20. Lock/Roll in Manual Lock	3-2
	3-23. Auto Lock Modes (System Controller)	3-3
	3-25. CW in Auto Lock	3-3
	3-27. CF/ $\Delta$ F in Auto Lock	3-3
	3-30. Start/Stop in Auto Lock	3-3
	3-33. Lock/Roll in Auto Lock	3-4
	3-37. Locked Sweeps CF/ $\Delta$ F and Start/Stop	3-4
	3-38. Sweep Time for Locked Sweeps	3-4

## TABLE OF CONTENTS (Continued)

Section	Title	Page
<b>OPERATION AND PROGRAMMING (Continued)</b>		
3-40.	Sweep Increment .....	3-4
3-43.	Markers .....	3-4
3-50.	Frequency Restrictions of Locked Sweeps .....	3-5
3-52.	Subharmonic Locking and Frequency Offset Locking Modes .....	3-5
3-53.	Subharmonic Locking Mode Overview .....	3-5
3-56.	Frequency Offset Locking Overview .....	3-5
3-59.	Hewlett-Packard RF Plug-Ins .....	3-6
3-62.	Basic YTO .....	3-6
3-64.	Basic YTO and Fixed Frequency Cavity Oscillator .....	3-7
3-66.	YTO and GaAs FET Doubler .....	3-8
3-68.	YTO and YTM .....	3-8
3-70.	Wide Band Plug-Ins .....	3-9
3-74.	Detailed Description of Subharmonic Locking Mode .....	3-9
3-80.	Detailed Frequency Offset Locking .....	3-10
3-89.	Frequency Multiplier .....	3-11
3-93.	MODE Switch (NORM/SUBHMNC on Rear Panel) .....	3-11
3-98.	Parameter Limits .....	3-12
3-100.	Locked Mode Restrictions .....	3-12
3-102.	Front Panel Features .....	3-15
3-104.	Rear Panel Features .....	3-20
3-106.	Function Key Operation .....	3-23
3-108.	5344A Display While Locked .....	3-23
3-111.	Operator's Check .....	3-24
3-112.	5342A/5343A Stand-Alone Operation .....	3-24
3-114.	Power-Up Self Check .....	3-24
3-119.	Errors and End of Sweep (----EOS----) Messages .....	3-25
3-121.	End-of-Sweep (EOS) Message .....	3-26
3-124.	Signal Source Requirements .....	3-26
3-126.	HP Signal Sources Used With the 5344S .....	3-27
3-128.	HP Sweeper Plug-In/5344S Compatibility .....	3-28
3-131.	Using the 5344S with an 8640A/B Signal Generator .....	3-29
3-133.	Detailed Operating Modes .....	3-30
3-136.	Common Control Problems .....	3-30
3-138.	Remote Programming Via the HP-IB Interface .....	3-56
3-139.	Introduction .....	3-56
3-142.	HP-IB Modes of Operation .....	3-56
3-145.	Programmable Mode .....	3-56
3-146.	Interface Functions Subset .....	3-56
3-148.	Bus Messages .....	3-57
3-150.	5344S Bus Message Response .....	3-58
3-151.	Address Selection .....	3-60
3-155.	Front Panel HP-IB Annunciators .....	3-60
3-157.	Command Codes .....	3-62
3-159.	HP-IB Command Code Syntax Diagrams .....	3-62
3-162.	Input Code Format .....	3-72
3-165.	Special Programming Considerations .....	3-73
3-169.	Output Format .....	3-73
3-171.	Remote Frequency Offset Locking .....	3-73
3-177.	System Controller Mode (Auto Lock) .....	3-74

## LIST OF TABLES

Table	Title	Page
1-1.	HP Model 5344A Specifications .....	1-2
1-2.	Equipment Supplied .....	1-5
1-3.	Accessories Available .....	1-5
1-4.	Available 5344S Options .....	1-6
1-5.	5342A/5343A Table of Options .....	1-7
1-6.	5342A/5343A Options Sensitivity .....	1-7
1-7.	Recommended Test Equipment .....	1-8
2-1.	HP-IB Cable Descriptions .....	2-7
3-1.	Parameter Limits .....	3-12
3-2.	Manual Lock Mode Restrictions .....	3-12
3-3.	Auto Lock Mode Restrictions .....	3-12
3-4.	5344A Display While Locked .....	3-23
3-5.	5344S Power-Up Parameters .....	3-24
3-6.	Errors Messages .....	3-25
3-7.	HP Sweeper Mainframe/5344A Compatibility .....	3-27
3-8.	HP 5sweeper Plug-In/5344A Compatibility .....	3-28
3-9.	8350A/8620 Series Connector Cross Reference .....	3-29
3-10.	Common Control Problems .....	3-30
3-11.	HP-IB Interface Functions .....	3-57
3-12.	HP-IB Messages .....	3-57
3-13.	Address Selection .....	3-61
3-14.	HP-IB Interface Functions (System Controller Mode) .....	3-74
3-15.	Condensed HP-IB Command Code Set .....	3-75

## LIST OF FIGURES

Figure	Title	Page
1-1.	Model 5344S Source Synchronizer and Equipment Supplied .....	1-0
2-1.	5344A Line Voltage Selection .....	2-1
2-2.	AC Power Cables Available .....	2-3
2-3.	Connecting 5344A to the 5342A (or 5343A) .....	2-5
2-4.	IF OUT Modification .....	2-6
2-5.	Hewlett Packard Interface Bus Connections .....	2-8
3-1.	Basic YIG Tuned Oscillator .....	3-6
3-2.	Basic YIG and Fixed Frequency Cavity Oscillator .....	3-7
3-3.	YIG Tuned Oscillator and GaAs FET Doubler .....	3-8
3-4.	YTO and YTM .....	3-8
3-5.	Wide Band Plug-In .....	3-9
3-6a.	Front Panel Features .....	3-13
3-6b.	Rear Panel Features .....	3-21
3-7.	5344A/8640A/B Interface Circuit .....	3-29
3-8.	CW in Manual .....	3-31
3-9.	CF/ $\Delta$ F in Manual .....	3-33
3-10.	Start/Stop in Manual .....	3-35
3-11.	Lock and Roll in Manual .....	3-37
3-12.	CW in AUTO LOCK .....	3-40
3-13.	CF/ $\Delta$ F in AUTO LOCK .....	3-42
3-14.	Start/Stop in AUTO LOCK .....	3-44
3-15.	Lock and Roll in AUTO LOCK .....	3-46
3-16.	Markers .....	3-49
3-17.	Subharmonic Locking Mode .....	3-52
3-18.	Frequency Offset Locking .....	3-54
3-19.	5344S Address Switches Set to Address 4 .....	3-60



# **SAFETY CONSIDERATIONS**

## **GENERAL**

This is a Safety Class I instrument. This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus".

This manual contains information, cautions, and warnings which must be followed by the service person to ensure safe operation and to retain the instrument in safe condition.

## **WARNINGS**

### **SAFETY**

If this instrument is to be energized via an autotransformer for voltage reduction, make sure the common terminal is connected to the earthed pole of the power source.

**BEFORE SWITCHING ON THIS INSTRUMENT**, the protective earth terminals of this instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding).

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

### **GROUNDING**

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal is likely to make this instrument dangerous. Intentional interruption is prohibited.

### **HIGH VOLTAGE**

**Warning** — These servicing instructions are for use by qualified personnel only. To avoid dangerous electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

## CAUTIONS


### LINE VOLTAGE SELECTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the instrument is set to the voltage of the power source. Verify that the power module is matched to the available line voltage. Verify that the correct fuse is installed.

### GROUNDING

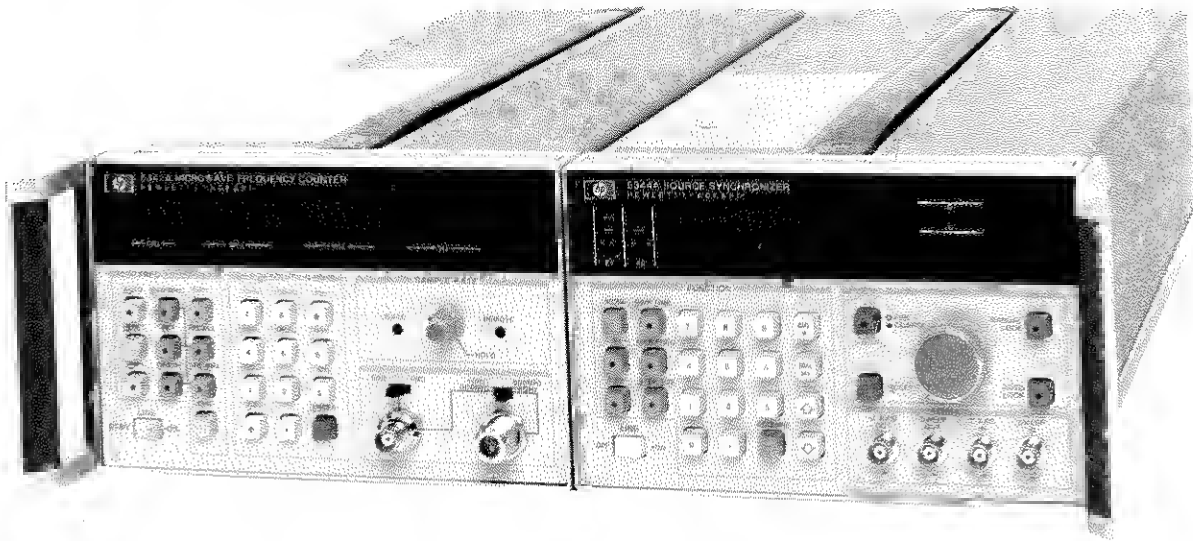
BEFORE SWITCHING ON THIS INSTRUMENT, ensure that all devices connected to this instrument are connected to the protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)



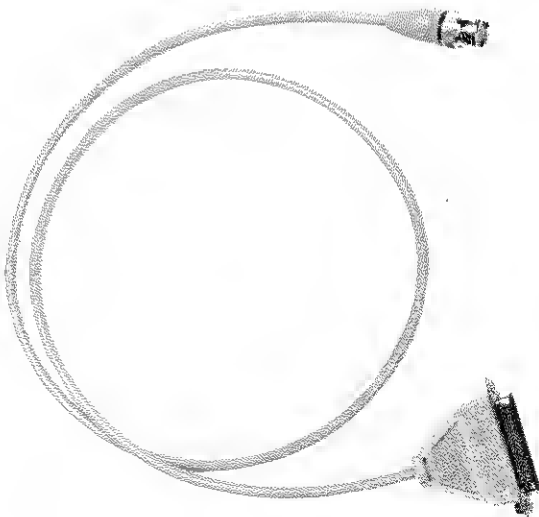
This symbol:  , which appears on the instrument means: Read the instruction manual before operating the instrument. If the instrument is operated without reading the instructions, it may not operate correctly.



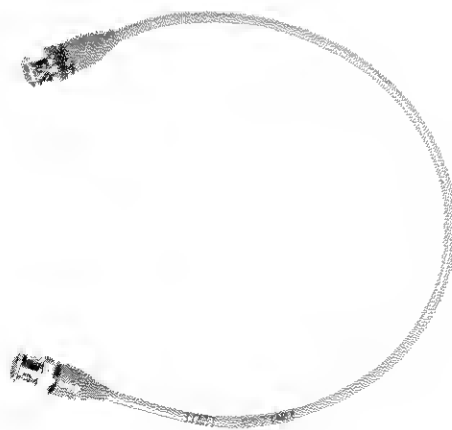
5342A/5344A



5344S SOURCE SYNCHRONIZER



**8350A EXTERNAL SWEEP TRIGGER CABLE**  
Part Number 8120-3545



**IF AND 10 MHz 18" BNC-BNC CABLES (2)**  
Part Number 8120-3370

NOTE: Refer to *Figure 4-1* for cable installation.

*Figure 1-1. Model 5344S Source Synchronizer and Equipment Supplied*

## **SECTION I GENERAL INFORMATION**

### **1-1. INTRODUCTION**

1-2. This manual provides information pertaining to the installation, operation, programming, testing, adjustments, and maintenance of the HP Model 5344S Microwave Source Synchronizer, shown in *Figure 1-1*.

1-3. The 5344S is comprised of the 5344A Source Synchronizer and the 5342A Microwave Frequency Counter with an Option 001 High Stability Timebase and Option 001 HP-IB Interface. These two instruments are electrically and mechanically connected at the factory, before shipment. The 5344S Option 043 replaces the 5342A with the 5343A (26.5 GHz) Microwave Frequency Counter.

### **1-4. INSTRUMENTS COVERED BY MANUAL**

1-5. This manual covers the operation of the 5344S Microwave Source Synchronizer system and covers the service of the 5344A instrument. The service and specific operation of the 5342A/5343A counter is described in its own Operating and Service Manual. The 5344A has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL PREFIX on the title page. There is no serial number for the 5344S system, only the individual serial numbers for the instruments (5344A and 5342A/5343A counter.).

1-6. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains change information that documents the differences. Older instruments have lower serial prefix numbers and the differences are described in Section VII.

### **1-7. OPERATING MANUAL**

1-8. Packaged with this manual is an Operating Information Supplement. This is a copy of the first three sections of this manual. This supplement should be kept with the instrument for use by the operator. Additional copies of the Operating Information Supplement or the Operating and Service Manual can be ordered through your nearest Hewlett-Packard Sales and Support Office (a list of these offices is provided at the end of the manual.) The part numbers are listed on the title page of this manual.

### **1-9. SPECIFICATIONS**

1-10. The specifications for the 5344S are listed in *Table 1-1*. These specifications are the performance standards or limits against which the 5344S may be tested.

1-11. Also listed on the title page of this manual following the Operating and Service Manual and the Operating Information Supplement part numbers are the Microfiche part numbers for these publications. These numbers can be used to order 4- X 6-inch microfilm transparencies of these publications. The Microfiche package includes the latest Manual Changes supplement and all pertinent Service Notes.

Table 1-1. Model 5344A Specifications

## INPUT CHARACTERISTICS

INPUT 1:	5342A	5343A (5344S Option 043)
<b>Frequency Range:</b>	500 MHz—18 GHz	500 MHz—26.5 GHz
<b>Sensitivity:</b> 500 MHz—12.4 GHz 12.4 GHz—18.0 GHz 18.0 GHz—26.5 GHz	-25 dBm -20 dBm —	-33 dBm -28 dBm -23 dBm
<b>Maximum Input:</b>	+7 dBm	+7 dBm
<b>Dynamic Range:</b> 500 MHz—12.4 GHz 12.4 GHz—18.0 GHz 18.0 GHz—26.5 GHz	32 dB 27 dB	40 dB 35 dB 30 dB
<b>Damage Level:</b>	+25 dBm, peak	+25 dBm, peak
<b>Impedance:</b>	50 ohms, NOMINAL	50 ohms, NOMINAL
<b>Connector:</b>	Precision Type N female	APC-3/5 male with collar (SMA compatible)
<b>SWR:</b> 500 MHz—10 GHz 10 MHz—18 GHz 18 MHz—26.5 GHz	<2:1 TYPICAL <3:1 TYPICAL —	<2:1 TYPICAL <3:1 TYPICAL <3:1 TYPICAL
<b>Coupling:</b>	DC to load, AC to instrument	DC to load, AC to instrument
<b>FM Tolerance:</b> switch selectable on rear panel. For modulation rates from DC to 10 MHz	Wide: 50 MHz p-p worst case Normal: 20 MHz p-p worst case	Wide: 50 MHz p-p worst case Normal: 20 MHz p-p worst case Narrow: 6 MHz p-p worst case
<b>AM Tolerance:</b>	Any modulation index provided the minimum signal level is not less than the sensitivity specification.	
<b>Modes of Operation:</b>	Automatic: Counter automatically acquires and displays highest level signal within sensitivity range. Manual: Center frequency entered to within $\pm 40$ MHz (TYPICAL) of true value; $\pm 25$ MHz (TYPICAL) below 825 MHz	
<b>Acquisition Time:</b> Automatic mode: Manual mode:	Normal FM: 530 ms worst case Wide FM: 2.4 s worst case  80 ms after frequency entered	Narrow FM: 200 ms worst case Normal FM: 530 ms worst case Wide FM: 2.4 s worst case 80 ms after frequency entered
<b>Automatic Amplitude Discrimination</b> Automatically measures the largest of all signals present, providing that signal is:	6 dB above any signal within 500 MHz; 20 dB above any signal, 500 MHz—18 GHz	6 dB above any signal within 500 MHz; 20 dB above any signal, 500 MHz—26.5 GHz

### 5342A and 5343A (5344S Option 043)

INPUT 2:	TIME BASE:
<b>Frequency range:</b> 10 Hz to 520 MHz Direct Count <b>Sensitivity:</b> 50 $\Omega$ 10 Hz to 520 MHz 25 mV rms; 1 M $\Omega$ 10 Hz to 25 MHz 50 mV rms <b>Impedance:</b> Selectable: 1 M $\Omega$ , <50 pF or 50 $\Omega$ NOMINAL <b>Coupling:</b> ac <b>Connector:</b> Type BNC female <b>Maximum input:</b> 50 $\Omega$ 3.5 Vrms (+24 dBm) 5 Vdc fuse protected; 1 M $\Omega$ 200 Vdc + 5.0 Vms	<b>Crystal frequency:</b> 10 MHz <b>Stability:</b> Aging rate: $<5 \times 10^{-10}$ /day after 24-hour warm-up Short-term: $<1 \times 10^{-10}$ for 1 s avg. time Temperature: $<7 \times 10^{-9}$ over the range 0°C to 50°C Line variation: $<1 \times 10^{-10}$ for 10% change from nominal Warm-up: $<5 \times 10^{-9}$ of final value 20 minutes after turn on, at 25°C  <b>Output frequency:</b> 10 MHz, $\geq 2.4$ V square wave (TTL compatible); 1.5V peak-to-peak into 50 $\Omega$ available from rear panel BNC. <b>External time base:</b> Requires 10 MHz, 3.0V peak-to-peak (2.4V peak-to-peak TYPICAL) sine wave or square wave into 1 k $\Omega$ via rear panel BNC connector. Switch selects either internal or external time base.

## GENERAL

**Accuracy:**  $\pm 1$  count  $\pm$  time base error  
**Resolution:** Front panel pushbuttons select 1 Hz to 1 MHz  
**Residual stability:** When counter and source use common timebase or counter uses external higher stability timebase  $<4 \times 10^{-11}$  rms TYPICAL  
**Display:** 11 digit LED display, sectionalized to read GHz, MHz, kHz, and Hz  
**Self-check:** Selected from front panel pushbuttons. Measures 75 MHz for resolution chosen  
**Frequency offset:** Selected from front panel pushbuttons. Displayed frequency is offset by entered value to 1 Hz resolution  
**Sample rate:** Variable from less than 20 ms between measurements to HOLD which holds display indefinitely  
**IF out:** Rear panel BNC connector provides 25 MHz to 125 MHz output of down-converted microwave signal.  
**Remote Programming Interface:** HP-IB (Hewlett-Packard's implementation of IEEE standard 488)  
**Functions controlled:** All front panel functions with the exception of the line switch and 50  $\Omega$ —1 M $\Omega$  switch are programmable.  
**Shorthand interface function codes:** SH1, AH1, T1, L2, SR1, RL1, PP0, DC1, DT1, C0, E1.

### 5343A Only (5344S Option 043)

**Multiply routine:** Selected from front panel pushbuttons. Measured frequency is multiplied by any integer up to 99. Then offset can be added or subtracted for  $y = mx \pm b$  result  
**Totalize:** Input 2 can totalize at rate up to 520 MHz. Readout on the fly is controlled by front panel or HP-IB  
**External trigger:** TTL type low level or contact closure to ground ( $>50 \mu$ s TYPICAL) at rear panel SMC male connector (A) initiates measurements when in sweep mode  
**Sweep inhibit:** TTL type low level from rear panel SMC male connector (B) inhibits sweeper during counter measurement when in sweep mode  
**Sweep mode:** Selected from front panel pushbutton. Allows interface to appropriate sweeper (e.g. 8350A) for start, stop, and marker frequency measurements.

Specifications describe the instrument's warranted performance. TYPICAL or NOMINAL performance characteristics provide useful applications information but are not warranted.

Table 1-1. Model 5344A Specifications (Continued)

## SPECIFICATIONS

**Frequency Coverage:** 500 MHz — 18 GHz  
500 MHz — 26.5 GHz (5344S  
Option 043)

**Resolution:** 1 Hz

**Long-Term Stability:** Equal to timebase in counter

	Standard (5342A)	Option 043 (5343A)
<b>Minimum Lock Level:</b>		
500 MHz — 12.4 GHz	-22 dBm	-30 dBm
12.4 GHz — 18.0 GHz	-19 dBm	-25 dBm
18.0 GHz — 26.5 GHz	—	-20 dBm

**Lock Time (TYPICAL):** Dependent on source  
Typical times with 8350A/83592A source

**Manual Lock:** 900 ms { Apply to CW or LOCK/ROLL modes,  
**Auto Lock:** 1.5 s { For CF/ΔF or START/STOP add  
300 ms.

**Option 043:** All lock times reduced by 400 ms

**Accuracy (CW):** Equal to counter accuracy

**Capture Range† (Manual Mode):**

**CW or LOCK/ROLL (start frequency):** ±25 MHz  
for sources with FM sensitivity greater or equal to  
5 MHz/V. Five volts x FM sensitivity for sources  
less than 5 MHz/V sensitivity.

**CF/ΔF or START/STOP:** Above conditions reduced by  
(0.5) x (span width)

**FM Output Connector:** Rear panel BNC female

**FM Output Drive:** ±10 V in series with 250 ohms

**Polarity:** Automatic selection

**Loop Bandwidth:** Rear panel switch selectable

**Narrowband (NB):** 10 kHz TYPICAL  
**Wideband (WB):** 100 kHz TYPICAL

## Required Source Characteristics

- Output frequency and level which meet input specifications for the 5344S
- An FM input port with a sensitivity between 1 and 50 MHz/V and bandwidth of DC to 2 MHz (minimum) for 5344S wideband mode or DC to 200 kHz (minimum) for narrowband mode
- Any FM input impedance which will satisfy requirement #2 with a 250 ohm resistance in series with FM input port

## Phase Noise — Locked Spectrum:

Dependent on source. Typical values for 8350A/83592A sweeper are:

Single-Sideband Phase Noise (1 Hz BW, CW mode, 6 MHz/V, narrowband,  $F_c = 6$  GHz)

Offset

from Carrier    10 Hz    100 Hz    1 KHz    10 KHz    100 KHz

SSB Level    -5 dBc    -35 dBc    -45 dBc    -45 dBc    -100 dBc

## Operating Characteristics

**Instrument Control:** Instrument parameters may be set up in three ways. The control knob with coarse and fine modes allows for continuous adjustment of the parameter of interest.

\*Auto Lock feature available when 5344S is used with 8350A or 8620C  
Option 011.

†Unless limited by output drive capability.

An exact parameter value can be entered through the Data Entry Keyboard. For incrementing or decrementing frequency values, the Step Keys (Step Up/Step Down) can be used. The Step Size is defined by the user.

**Bar Meter:** A front panel, 10 segment, center scale bar meter indicates the frequency correction signal, from FM OUT connector, being supplied to the signal source.

## Operating Modes

### CW:

**Manual Lock** — Source is manually tuned to within capture range of desired frequency. Lock is achieved and is indicated when LOCKED light annunciator turns on. If source frequency is outside capture range, the FREQ HI or FREQ LO light turns on.

**Auto Lock\*** — Source is tuned automatically by the 5344S via the HP.IB. to bring it into lock.

**Note:** Refer to signal source compatibility chart for appropriate source.

**CF/ΔF Sweep (Manual Lock or Auto Lock\*):** Performs a phase continuous locked sweep from  $CF - 1/2\Delta F$  to  $CF + 1/2\Delta F$  in a sweep time defined by the user. Sweeps up to 40 MHz are available, dependent on the source. If source is too far from desired frequency range, the user must tune source (Manual Lock) or the 5344S automatically tunes (Auto Lock) via the HP.IB. The LOCKED light indicates a proper locked condition. Marker signals are available within the swept range.

**START/STOP Sweep (Manual Lock or Auto Lock\*):** Performs a phase continuous locked sweep from START frequency to STOP frequency over a sweep time defined by the user. Sweeps up to 40 MHz are available dependent on the source. The STOP frequency must be greater than or equal to START frequency. If the source frequency is too far from the desired frequency range, the user must tune (Manual Lock) source or the 5344S will automatically tune (Auto Lock) via the HP.IB. The LOCKED light indicates a locked sweep condition. Marker signals are available within the swept range.

### Accuracy — CF/ΔF and START/STOP modes

**Start or Stop Frequencies:** 1 kHz TYPICAL

**Linearity:** ±0.05% of sweep with respect to Sweep Out voltage (TYPICAL)

**Resolution:** 1 Hz for CF, ΔF, START, and STOP frequencies  
**Sweep Time:** Available in CF/ΔF and START/STOP modes. Continuously adjustable from 10 ms to 100 s. When sweep time is selected, user may toggle between continuous and single sweep by pressing the ACQUIRE key. The RESET key initiates a sweep when in single sweep sub-mode.

**Marker Frequencies:** Available in CF/ΔF and START/STOP modes. Up to four frequency markers are settable across the swept band. Markers are adjustable with the control knob, data entry keyboard, or step keys to 1 Hz resolution.

**Accuracy:** 0.3% of sweep width TYPICAL

**Marker Output:** Rectangular pulse, -5 volts peak (TYPICAL) available from the Z-axis Out connector on front panel. Source impedance approximately 500 ohms.

**LOCK/ROLL (Manual Lock or Auto Lock\*):** Sweep is phase-locked by the 5344S to a precise start frequency and then control is transferred to the sweeper to complete the sweep. The source determines sweep time, marker frequencies, and stop frequency.



Table 1-1. Model 5344A Specifications (Continued)

If source is too far from desired frequency, the user must tune source (Manual Lock) or the 5344S can automatically tune (Auto Lock) via the HP-IB. The LOCKED light indicates a proper locked condition.

#### Start Frequency

Resolution: 1 Hz  
Accuracy: Equal to counter accuracy  
Residual stability: <50 kHz rms TYPICAL

**5344S Option 043:** With the 5343A microwave counter installed, special interface cables can be connected to the 8350A to enhance measurements. The marker frequencies and stop frequency can be measured by the counter with improved accuracy ( $\pm 100$  kHz TYPICAL)

### Subharmonic/Offset Mode

Mode is selected by rear panel switch and indicated by a decimal point in far right of numeric display. Multiplier type sources (eg., HP 83570A, 83590A, 83592A, 83594A, 83595A, 86290) can be phase locked via the subharmonic frequency available on the Auxiliary Output connector. The actual output frequency is displayed on the 5344S while locking to the subharmonic output.

\*Auto Lock feature available when 5344S is used with 8350A or 8620C Option 011.

Offset mode is used for sources that generate RF frequencies by heterodyning a variable oscillator with a fixed oscillator. When the variable oscillator is available at the Auxiliary Output (eg. HP 83592A, 83595A), the 5344S can display the actual source output frequency, while phase locking to the Auxiliary Output, after entering the appropriate frequency offset on the counter. Accuracy is now limited by stability of the fixed oscillator (<20 kHz rms TYPICAL for 83592A, 83595A).

Subharmonic/Offset mode can be useful for any general purpose sources used with external multipliers and mixers.

### Acquire Function

Acquires a frequency measurement from the counter and places the value in the numeric display when unlocked.

### HP-IB Operation

#### Remote Programming

**Interface:** HP-IB (Hewlett-Packard's implementation of IEEE Standard 488)

**Functions controlled:** All front panel functions with the exception of the line switch and Auto Lock are programmable.

**Shorthand Interface Function Codes:** SH1, AH1, T2, L2, SR1, RL1, PP0, DC1, DT1, C0, E1

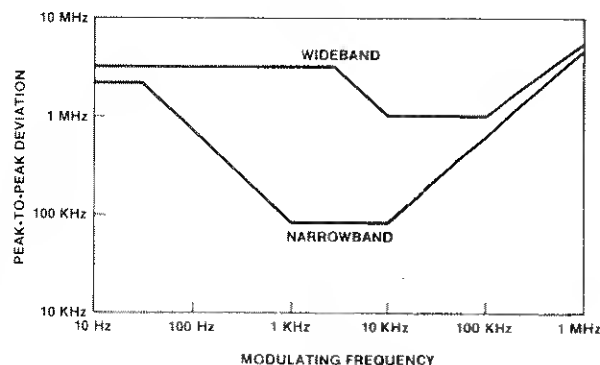
**Standalone:** The 5344A is connected to the source via HP-IB and acts as the controller. Rear panel switch selectable. This mode accomplishes Auto Lock.\*

### Maximum FM (TYPICAL)

Phase lock will be maintained if the maximum FM on source is not exceeded at the various modulating frequencies.

### GENERAL

**Z-Axis In:** Accepts the Z-Axis modulation signal from sweeper. Tied directly to Z-Axis Out for LOCK/ROLL mode. Otherwise has no effect. Front panel BNC female connector.



**Z-Axis Out:** Provides a Z Axis modulation signal for display devices. Is generated by the 5344A when in locked sweep modes (CF/ $\Delta$ F or START/STOP) and is a direct-coupled rectangular pulse of approximately +5.0 volts peak during retrace. Intensity marker signals are also output through this connector. At all other times is tied directly to Z-Axis In. Front panel BNC female connector.

**Sweep In:** Accepts the sweep out signal from the sweeper as required in LOCK/ROLL mode and ties it directly to the Sweep Out connector. Otherwise has no effect. Front panel BNC female connector.

**Sweep Out:** Provides a linear ramp voltage from 0 to 10 volts synchronous with the swept RF output when in locked sweep mode (CF/ $\Delta$ F or START/STOP). Otherwise, Sweep Out is tied directly to Sweep In. Front panel BNC female connector.

**Sweep Trigger:** Output signal necessary in LOCK/ROLL mode for connection to Ext Trigger connector on sweeper. Signal is greater than +2V dc and wider than 2 ms (TYPICAL). Rear panel BNC female connector.

**10 MHz In:** Must be connected to the Freq. Std. Out (10 MHz) from the rear panel of counter. Rear panel BNC female connector.

**IF In:** Must be connected to the IF Out signal from the rear panel of the counter. Rear panel BNC female connector.

**Operating Temperature:** 0°C to 50°C

**Power Requirements:** 100/120/220/240 V rms, +5%, -10%, 48-66 Hz; 125 VA max (5344A) plus 100 VA Max (5342A)

#### Accessories Furnished:

Power cords (2), 229 cm. (7 1/2 ft.)

BNC cables (2), 46 cm (18 in.)

Sweep trigger interface cable for 8350A 1m (39 in.)

**Size:** 133 mm H x 426 mm W x 498 mm D (5 1/4" x 16 3/4" x 19 5/8")

**Weight:** Net 18.7 kg (41 lbs.) Shipping 25.9 kg (57 lbs.)

### Signal Source Compatibility Chart — HP Sweepers

8350A Sweep Oscillator: MANUAL LOCK and AUTO LOCK

8620A/B and 8620C (without Option 011) Sweep Oscillator: MANUAL LOCK

8620C (Option 011) Sweep Oscillator: MANUAL LOCK and AUTO LOCK except no AUTO LOCK/ROLL

8683A/B and 8684A/B Signal Generators: MANUAL LOCK

Specifications describe the instrument's warranted performance. TYPICAL or NOMINAL performance characteristics provide useful applications information but are not warranted.



## 1-12. SAFETY CONSIDERATIONS

1-13. This product is used as part of a Safety Class I instrument (provided with a protective earth terminal.) Safety information pertinent to the operation and servicing of this instrument is included in appropriate sections of this manual.

## 1-14. EQUIPMENT SUPPLIED

1-15. The equipment supplied with the 5344S is listed in Table 1-2.

Table 1-2. Equipment Supplied

Description	Quantity	Part Number
18" BNC-BNC Cable (See Figure 4-1)	2	8120-3370
*Processor Interface Cable (See Figure 2-3)	1	8120-3435
Power Cables	2	8120-1378
*Front Handles	2	5060-9899
8350A External Sweep Trigger Cable	1	8120-3545
Locking Hardware (5344A to Counter)	1	
*Front Link Locks	4	0050-0515
*Screws for above 8-32 × 1/4"	4	2510-0192
*Processor Interface Cable Shield	1	05344-00006
*Screws for above 6-32 × 3/8"	4	2360-0117
*Flat washers for above	4	3050-0066
*IF OUT Modification		
IF OUT cable assembly *	1	05344-60114
Tie-wraps *	3	1400-0249

\*These items are factory installed in a standard 5344S and 5344S Opt 043 (5344A and counter.)

## 1-16. EQUIPMENT AVAILABLE

1-17. Equipment available for use with the 5344S is listed in Table 1-3.

Table 1-3. Equipment Available

*Service Accessory Kit	10842A
Transit Case	P/N 9211-2655
Male BNC-to-Female SMC cables (5343A)	11592-60001
5343A 5sweep Interface Cables	
APC-3.5 Adapter (female-to-female)	P/N 1250-1709
APC-3.5 (female) to N (female) Adapter	P/N 1250-1745
Model 5006A Signature Multimeter	See separate data sheet
Model 5001A Microprocessor Exerciser	See separate data sheet
Model 8350A Microwave Sweep Oscillator	See separate data sheet
Model 8620C Microwave Sweep Oscillator	See separate data sheet

\*The 10842A contains eleven special extender boards and is supplied with Installation Note 10842-90004.

## 1-18. DESCRIPTION

1-19. The Hewlett-Packard Model 5344A is a companion instrument for the 5342A or 5343A Microwave Frequency Counter. This two instrument system is called the 5344S Source Synchronizer which provides the ability to obtain high stability and high resolution frequencies from various voltage controllable signal generators, such as the 8620A/B/C, 8640A/B, 8683A/B, 8684A/B, and

8350A. Refer to *Tables 3-7 and 3-8* for details on compatible sweep generators and plug-ins, respectively. The front panel keyboard of the 5344A provides controls to:

1. Select a specific frequency to 1 Hz resolution.
2. Select a center frequency and sweep over a range of  $\pm 20$  MHz. Sweep time is also selectable.
3. Select a Start and Stop frequency and sweep over this range. Sweep time is also selectable.
4. Make wideband sweeps limited only by the sweep oscillators range.
5. Generate up to four markers during locked sweeps (CF/ $\Delta$ F and Start/Stop).

#### NOTE

If the 5344A is to be added to an existing 5342A or 5343A, option 001 high stability oscillator should be installed in the counter. Option 001 determines the stability of the system and is required to maintain its integrity. In addition, the rear panel IF OUT connector must be modified as described in paragraph 2-23. The required materials for this modification are supplied with the 5344S Option 142.

### 1-20. Model Numbers

1-21. This manual contains operating information for the 5344S Microwave Source Synchronizer. However, at various points it is necessary to discuss different instruments that comprise the 5344S. To help clarify this, the following model numbers are used throughout the manual:

5344S—Used when discussing the complete system (counter and 5344A).

5342A or 5343A—Used when discussing the counter only.

5344A—Used when discussing the 5344A instrument only.

### 1-22. OPTIONS

1-23. The 5344A Source Synchronizer is typically ordered with a 5342A Microwave Frequency Counter as the 5344S System. However, several options are available with the 5344S, such as deleting the 5342A Microwave Frequency counter and replacing it with the 5343A Microwave Frequency Counter (Option 043). *Table 1-4* lists the available options for the 5344S.

*Table 1-4. Available 5344S Options*

Option	Description
Standard	5344A and 5342A Option 001*, 011** Microwave Frequency Counter
142	5344A Source Synchronizer Only; deletes the 5342A Microwave Frequency Counter. Includes all interfacing hardware and materials to modify IF OUT BNC. (See paragraph 2-23.)
043	Deletes 5342A Microwave Frequency Counter and replaces it with a 5343A Counter †
908	Adds Rack Mount Flange Kit
910	Adds an extra set of manuals
913	Adds Rack Mount Flange Kit with Handles

\*5342A Option 001 and 5343A Option 001 adds the High Stability Oscillator 10544A.

\*\*5342A Option 011 and 5343A Option 011 adds Hewlett-Packard Interface (HP-IB)

†A 5344S System containing a 5343A Microwave Frequency Counter can be operated to 26.5 GHz. The 5343A will include Option 001 and 011.



## 1-24. Ordering Special 5344S Combinations

1-25. The 5342A and 5343A each have options available as listed in Table 1-5. Two of these options (Options 001 and 011) are standard equipment with the 5342A in the 5344S System. However, there may be a desire to have one or more of the other available options. For example, you may want to include Option 002 Amplitude Measurement with the 5342A in the system. To order a 5344S System with Options 002, 003, and/or 004 installed in the counter, order the 5344S Option 142. This deletes the counter (but still includes all the necessary interfacing hardware). Then order the desired counter with the options. Once the separate instruments are received, they must be connected as described in paragraph 2-19. In the case described above, you would order:

1. 5344S System Option 142 - Deletes the 5342A counter and:
2. 5342A Option 001, 002 and 011.

1-26. When ordering in this configuration, be sure to order Options 001 High Stability Oscillator, for the counter. Option 001 High Stability Oscillator is the key to the 5344S Source Synchronizer System's stability.

1-27. For complete remote control of the 5344S system, Option 011 HP-IB should be installed in the counter. HP-IB is required in the counter only for Frequency Offset Locking under remote control. If HP-IB is not installed in the counter, the offset must be entered manually. See paragraphs 3-56 and 3-80.

### NOTE

The 5344A can automatically recognize the counter to which it is attached. Once this has been determined, the 5344A will limit the maximum frequency to 18 GHz for the 5342A and 26.5 GHz for the 5343A. If the 5342A has Option 005 (operation to 24 GHz), the 5344A will still limit the operation to 18 GHz. However, when the 5342A is not being used with the 5344A (Manual and Auto Lock off), the 5342A Option 005 will operate as normal to 24 GHz.

Table 1-5. 5342A/5343A Table of Options

5342A	5343A	Description
001	001	High Stability Oscillator 10544A
002	N/A	Amplitude Measurement
003	N/A	Extended Dynamic Range
004	004	Digital-to-Analog Converter
005	N/A	Operates to 24 GHz
006	006	Microwave Limiter
011	011	Hewlett-Packard Interface Bus (IEEE 488-1978)

See the appropriate counter manual for specifications and operating details for these options.

N/A Not Available

## 1-28. Operation of Counter Options with the 5344A

1-29. Certain options for the 5342A and 5343A Microwave Frequency Counters reduce the input sensitivity. Table 1-6 lists the options and the sensitivity levels for those options.

Table 1-6. 5342A/5343A Options Sensitivity

Option	5342A	5343A
002 and 003		
.5 - 12.4 GHz	-19 dBm	_____
12.4 - 18 GHz	-14 dBm	_____
006		
.5 - 12.4 GHz	-18 dBm	-27 dBm
12.4 - 18 GHz	-14 dBm	-21 dBm
18 - 26.5 GHz	_____	-15 dBm



1-30. Options 002 Amplitude Measurement (5342A only) and 004 Digital-to-Analog Converter (5342A/5343A) will be automatically turned off whenever the 5344S is placed into Manual or Auto Lock mode. They will be re-activated when Manual or Auto Lock is turned off again. Option 011 HP-IB Interface for either counter is locked out whenever the 5344A is in Remote mode and Manual Lock or Auto Lock is on (but the 5344S is not necessarily Locked.) Any offset entered into the counter through the HP-IB will remain active. See paragraph 3-171, Remote Frequency Offset Locking.

## 1-31. RECOMMENDED TEST EQUIPMENT

1-32. The test equipment listed in Table 1-7 is recommended for use during performance tests, adjustments, and troubleshooting. Substitute test equipment may be used if it meets the required characteristics listed in the table.

Table 1-7. Recommended Test Equipment

Instrument	Critical Specs	Model	Use
Spectrum Analyzer	500 MHz-18 GHz	HP 8565A	O,P
Microwave Counter	500 MHz-26.5 GHz	HP 5343A	O,P
Controller	IEEE 488-1978	HP 85A*	O,P
Sweep Mainframe	5344S Compatible	HP 8350A	O,P
8350A/8620A/B/C Plug-ins	500 MHz-26.5 GHz	HP 86595A	O,P
uP Exerciser	For use with M6800	HP 5001A	T
Signature Multimeter	Signature analysis, multimeter functions	HP 5005A/B	T
Oscilloscope	100 MHz bandwidth	HP 1740A	O,P,T
Oscilloscope	275 MHz bandwidth	HP 1725A	T
Power Splitter	DC-18 GHz	HP 11667A	O,P
Directional Coupler	7 - 18 GHz	HP 11691D	O,P
Crystal Detector	.5 - 18 GHz	HP 8476A	O,P
Digital Multimeter	20V Range	HP 3465A	A
Spectrum Analyzer	20 Hz - 300 kHz Input	HP 141T/8556A/ 8552A	A,T
Service Accessory Kit	Complete Kit	10842A	T
10842A contains:	2 × 10 pin	05342-60030	T
(Only required boards are listed)	2 × 12 pin	05342-60031	T
	2 × 15 pin	05342-60032	T
	2 × 18 pin (2)	05342-60033	T
	2 × 22 pin (2)	05342-60034	T
	2 × 24 pin	05342-60035	T
	A14 Extender 5342A/43A	05342-60036	T
	†A9 Polarized Extender	05344-60014	T

A = Adjustments  
O = Operational Verification  
P = Performance Test  
T = Troubleshooting

\* The HP 85A requires the 00085-15003 I/O ROM (installed in the 82936A ROM Drawer), the 82903A 16K Memory Module, and the 82937A HP-IB Interface. An HP 85F may be substituted for the HP 85A and accessories.

† The 05344-60014 has been added to the 10842A Extender board kit. Earlier kits may not have this extender board. It should be obtained and added to the kit.

## SECTION II INSTALLATION

### 2-1. INTRODUCTION

2-2. This section contains information for unpacking, inspection, storage, installation, and connection to the Hewlett-Packard Interface Bus.

### 2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, inspect the instrument for visible damage (scratches, dents, etc.). If the instrument is damaged, notify the carrier and the nearest Hewlett-Packard Sales and Support Office immediately (the offices are listed at the back of this manual). Keep the shipping carton and packaging material for the carrier's inspection. The Hewlett-Packard Sales and Support Office will arrange for repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

### 2-5. PREPARATIONS FOR USE

#### 2-6. Power Requirements

2-7. The HP 5344A requires a power source of 100-, 120-, 220-, or 240-volt ac, +5%, -10 %, 48 to 66 Hz single phase. The power consumption is approximately 125 VA. See Section I, Specifications for description.

#### 2-8. Line Voltage Selection

#### CAUTION

Before connecting the instrument to ac power lines, be sure that the voltage selector is properly positioned as described in the following paragraph.

2-9. The 5344A is equipped with a power connector module that has a plug-in printed-circuit card line voltage selector to choose 100-, 120-, 220-, or 240-volt ac operation (see Figure 2-1). Before applying power, the selector card must be set to the correct position and the correct fuse must be installed as described in paragraph 2-13.

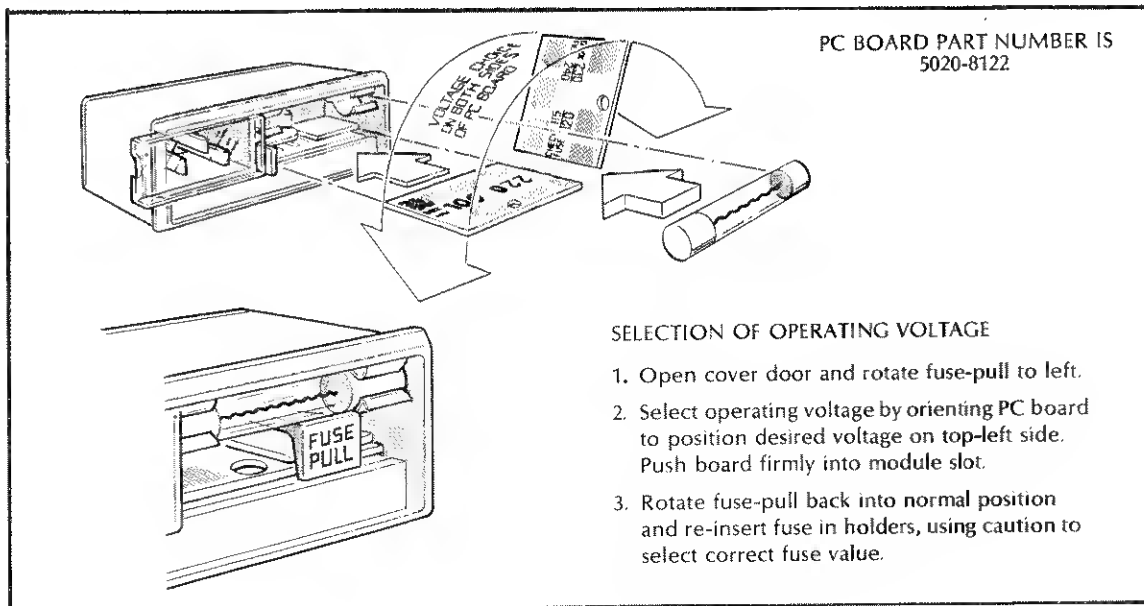


Figure 2-1. 5344A Line Voltage Selection

2-10. Power line connections are selected by the position of the plug-in card in the module. When the card is plugged into the module, the only visible markings on the card indicate the line voltage to be used. The correct value of line fuse, with a 250-volt rating, must be installed after the card is inserted.

2-11. To convert from one line voltage to another, the power cord must be disconnected from the power module before the sliding window covering the fuse and card compartment can be moved to expose the fuse and circuit card.

2-12. Pull on the fuse lever and then pull the card out of the module. The fuse lever must be held to one side to remove and insert the card. Insert the card so the marking that agrees with the line voltage to be used is visible.

2-13. Return the fuse lever to normal position, insert the correct fuse, slide the plastic window over the compartment, and connect the power cord to complete the conversion.

#### NOTE

For operation from 100V ac or 120V ac use a 1.25A slo-blo fuse (2110-0305). For 220V ac or 240V ac operation use a .75A slo-blo fuse (2110-0360).

#### 2-14. Power Cable

##### WARNING

**BEFORE CONNECTING ELECTRICAL POWER TO THIS INSTRUMENT, THE PROTECTIVE EARTH TERMINALS OF THIS INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE POWER CORD (MAINS). THE MAIN PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE DEFEATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).**

2-15. The 5344A is shipped with a three wire power cable. When the cable is connected to an appropriate ac power source, this cable connects the chassis to the earth ground. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of the power cables and plug configurations available.


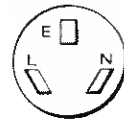
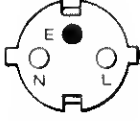
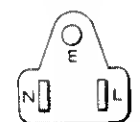

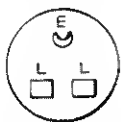
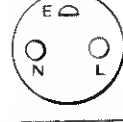
Plug Type	Cable HP Part No.	*CD	Plug Description	Cable Length (inches)	Cable Color	For Use In Country
<b>250V</b> 	8120-1351 8120-1703	0 6	Straight **BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Rhodesia, Singapore
<b>250V</b> 	8120-1369 8120-0696	0 4	Straight **NZSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
<b>250V</b> 	8120-1689 8120-1692	7 2	Straight **CEE7-Y11 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, So. Africa, India (unpolarized in many nations)
<b>125V</b> 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight **NEMA5-15P 90° Straight **NEMA5-15P 90° Straight **NEMA5-15P 90° Straight **NEMA5-15P	80 80 36 80 80 30	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
<b>250V</b> 	8120-2104	3	Straight **SEV1011 1959-24507 Type 12	79	Gray	Switzerland
<b>250V</b> 	8120-0698	6	Straight **NEMA6-15P			United States, Canada
<b>220V</b> 	8120-2956 8120-2957	2 3	Straight **DHCK 107 90°	79 79	Gray Gray	Denmark
<p>*CD = Check Digit (refer to Section VI).</p> <p>** Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.</p> <p>E = Earth Ground, L = Line, N = Neutral</p>						

Figure 2-2. AC Power Cables Available

## 2-16. Operating Environment

2-17. TEMPERATURE. The 5344A may be operated in temperatures from 0°C to 50°C.

2-18. ALTITUDE. The 5344A may be operated at altitudes up to 4,600 metres (15,000 feet).

## 2-19. Mating Counter to 5344A

2-20. If the 5344A and the 5342A (or 5343A) counter are ordered together (as the 5344S), they will be received as one unit connected together mechanically and electrically. However, if the 5344A is ordered separately and is to be connected to an existing counter, the following procedure should be performed. Refer to *Figure 2-3*.

- a. Unpack the 5344A and locate the mating hardware and cables listed below:
  1. Interface cable shield (aluminum plate with four square holes.)
  2. Four link locks.
  3. Four 6-32  $\times$  3/8" flat head pozidriv screws (for link locks).
  4. Four 6-32  $\times$  7/16" pan head pozidriv screws.
  5. Four flat washers (for 6-32  $\times$  7/16" screws).
  6. Counter to 5344A processor interface cable (ribbon type).
  7. Two 18" BNC-BNC cables.
  8. 8350A Sweeper Interface Cable.
  9. IF OUT modification cable and tie-wraps.
- b. Remove any handles or rack flanges from the counter.
- c. Using a 6-32  $\times$  3/8" flat-head screw, attach two of the link locks to the right-hand side of the counter. Orient the locks so they are open to the rear of the counter. Attach the locks to the top and bottom screw holes.
- d. Using the remaining two 6-32  $\times$  3/8" flat head screws, attach the remaining link locks to the left-side of the 5344A. Orient the locks so they are open to the front of the 5344A.
- e. Slide the counter and the 5344A together at the front frames. The link locks will mate together. Bring the rear frames together so the instruments are parallel.
- f. Looking at the rear of the two instruments, insert the processor interface cable, with the red stripe up, into the Processor Interface connectors.
- g. Orient the interface cable shield to align the square hole of the cover with the square mounts on the instrument's rear chassis frames.
- h. Secure the processor shield with the four 6-32  $\times$  7/16" pan-head pozidriv screws and flat washers.
- i. Using the two BNC-BNC cables, connect the counter FREQ STD OUT to the 5344A 10 MHz, and the counter IF OUT to the 5344A IF IN.
- j. Attach the handles and/or rack flanges to the 5344S.
- k. This completes the mating procedure. Additional connections will be made to the instruments as applications are described.



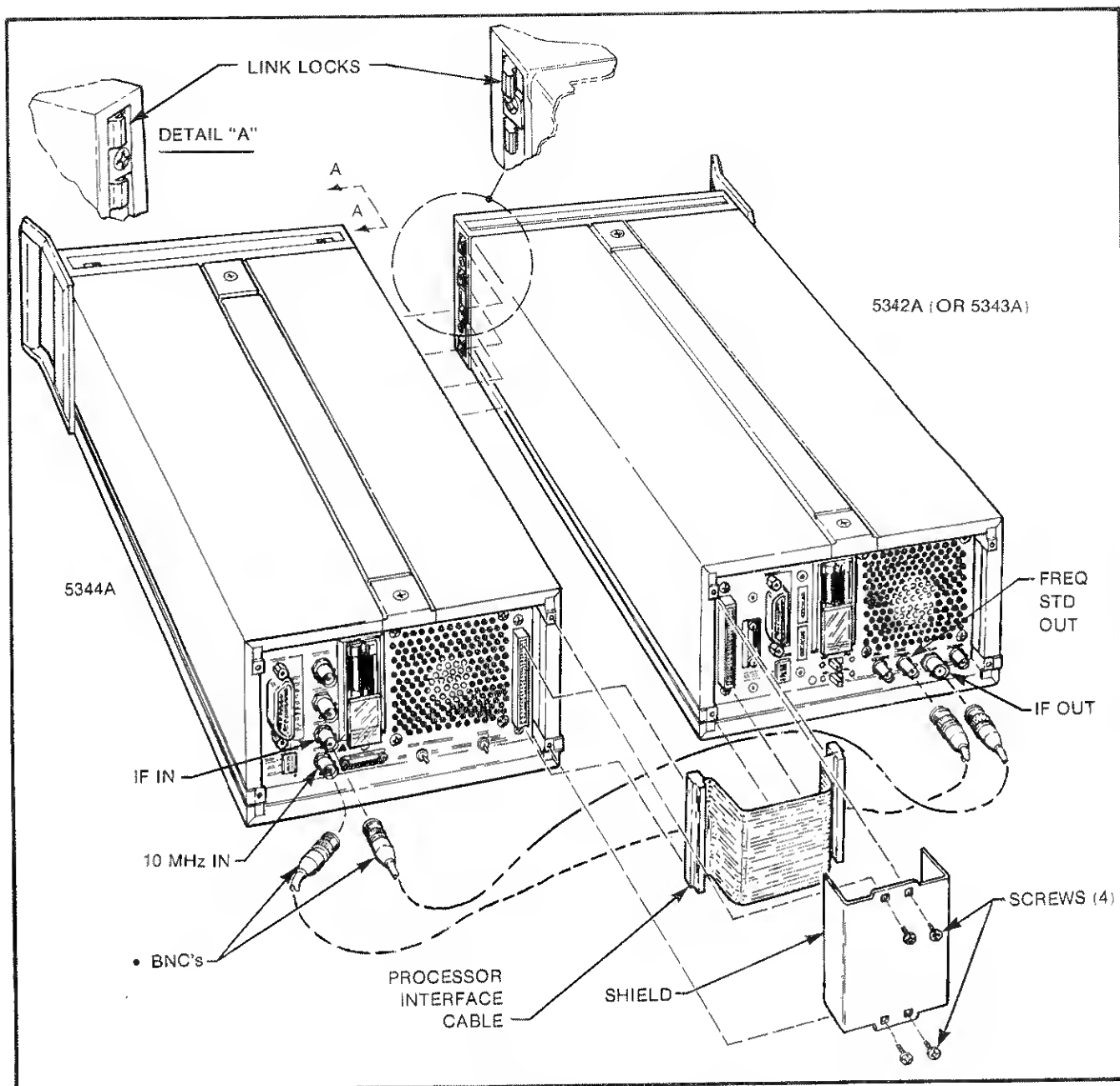


Figure 2-3. Connecting 5344A to the 5342A (or 5343A)

## 2-21. Compatibility with 5342A/43A Counters

2-22. The 5344A is compatible with all standard 5342A and 5343A Microwave Frequency Counters. However, certain serial number counters require a simple modification as described in the following paragraph.

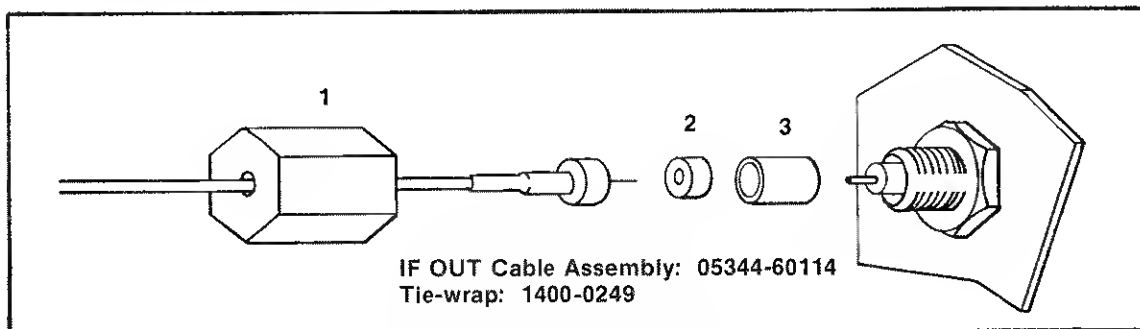
## 2-23. Required Modifications for Earlier Version 5342A/43A Counters

2-24. Earlier models of 5342A and 5343A counters require a modification to the IF OUT BNC (J4) on the rear panel. This requires adding a brass shield to BNC connector J4 (IF OUT). This is required on 5342A with serial numbers 2142A05040 and below and for 5343A serial numbers 2201A00625 and below. The following procedure describes this modification.

#### NOTE

This change is not required on counters received as part of a 5344S system or on counters with serial numbers higher than those listed in paragraph 2-24. Refer to *Figure 2-4* for IF OUT modification part numbers for required parts.

1. Remove all power from the 5342A/5343A counter.
2. Remove all four feet from the counters bottom cover.
3. Remove the top cover by removing the screw in the rear strap cap (securing the rear of the strap handle). Remove the cap and then slide the top cover toward the rear until it can be freely removed.
4. Using a large Pozidriv screwdriver rotate the screw located in the rear of the bottom cover counter-clockwise. As the screw is rotated, the cover will begin to slide backwards away from the instrument. Grasp the cover and assist its movement until it can be freely removed. The screw will remain attached to the rear cover.
5. Using a large Pozidriv screwdriver, remove the four screws securing the rear frame casting to the main frame struts.
6. Separate the rear frame casting, tilting the top forward to allow access to the IF OUT BNC connector J4.
7. Unsolder the IF OUT shielded cable from J4. Disconnect the opposite end of the cable from A27J2 located at the front of the instrument. Cut the three grey tie-wraps securing the cable bundle. Remove the cable.
8. Replace the IF OUT cable with the new cable supplied (05344-60114). Connect the new cable to A27J2 and route it to the rear panel just as the original cable. Resecure the cable bundle with the three supplied tie-wraps (1400-0249).
9. Remove the rear panel IF OUT BNC and replace it with the supplied BNC. Secure the BNC firmly.
10. Slide the brass barrel (1), nylon spacer (2), and a brass sleeve (3), onto the IF OUT shielded cable as shown in *Figure 2-4*.



*Figure 2-4. IF OUT Modification*

11. Insert the exposed wire into the center conductor of the BNC. While holding the cable in position, thread the BNC barrel onto the BNC. Pulling the rear panel back should provide enough room to thread the barrel.
12. Tighten the barrel firmly.
13. Re-assemble the counter by performing steps 2 through 6 in reverse order.
14. This completes the modification.



## 2-25. HP-IB Interconnections

2-26. HEWLETT-PACKARD INTERFACE BUS. Interconnection data concerning the rear panel HP-IB connector is provided in *Figure 2-5*. This connector is compatible with the HP 10833A/B/C/D cables. (See *Table 2-1* for cable descriptions.) The HP-IB system allows interconnection of up to 15 (including the controller) HP-IB compatible instruments. The HP-IB cables have identical "piggy-back" connectors on both ends so that several cables can be connected to a single source without special adapters or switch boxes. System components and devices may be connected in virtually any configuration desired. There must, of course, be a path from the calculator (or other controller) to every device operating on the bus. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too large, the force on the stack produces great leverage which can damage the connector mounting. Be sure each connector is firmly (finger tight) screwed in place to keep it from working loose during use.

Table 2-1. HP-IB Cable Descriptions

10833A	1 metre (3.3 ft.)
10833B	2 metre (6.6 ft.)
10833C	4 metre (13.2 ft.)
10833D	0.5 metre (1.6 ft.)



The above symbol when located in the upper corner of a page indicates HP-IB information is contained on that page. This information may be operation, performance, adjustment, or service related.

2-27. CABLE LENGTH RESTRICTIONS. To achieve design performance with the HP-IB, the proper voltage levels and timing relationships must be maintained. If the system cable is too long the lines cannot be drive properly, and the system will fail to perform properly. Therefore, when interconnecting an HP-IB system, it is important to observe the following rules:

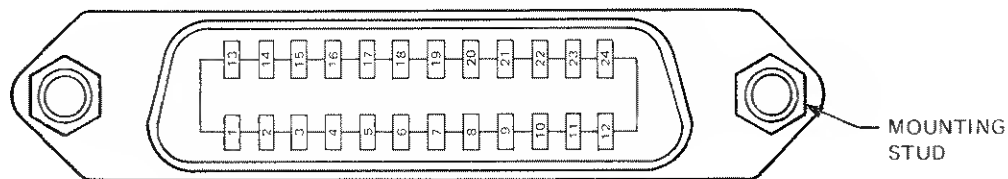
- The total cable length for the system must be less than or equal to 20 meters (65 feet).
- The total cable length for the system must be less than or equal to 2 meters (6.6 feet) times the total number of devices connected to the bus.
- The total number of instruments connected to the bus must not exceed 15.

## 2-28. 5344A Listen/Talk Address

2-29. The 5344A contains a rear panel HP-IB instrument address selection switch. There are five switches designated (A5, A4, A3, A2, A1) which are used to select the address. Instructions for setting and changing the address are provided in Section III of this manual along with the programming codes.

## 2-30. HP-IB Descriptions

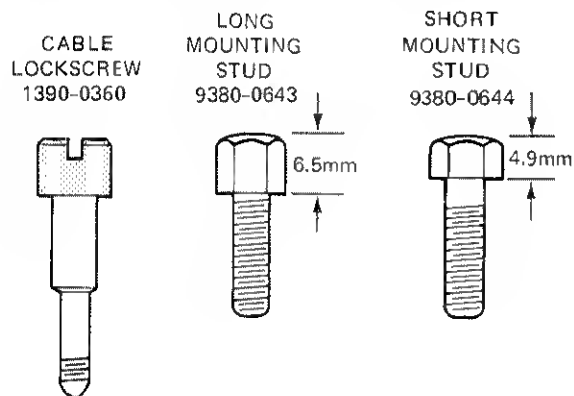
2-31. A description of the HP-IB is provided in Section III of this manual. A study of this information is necessary if the user is not familiar with the HP-IB concept. Additional information concerning the design criteria and operation of the bus is available in IEEE Standard 488-1978, titled "IEEE Standard Digital Interface for Programmable Instrumentation." See *Figure 2-5*.



PIN	LINE
1	DIO1
2	DIO2
3	DIO3
4	DIO4
13	DIO5
14	DIO6
15	DIO7
16	DIO8
5	EOI
17	REN
6	DAV
7	NREFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	SHIELD-CHASSIS GROUND
18	P/O TWISTED PAIR WITH PIN 6
19	P/O TWISTED PAIR WITH PIN 7
20	P/O TWISTED PAIR WITH PIN 8
21	P/O TWISTED PAIR WITH PIN 9
22	P/O TWISTED PAIR WITH PIN 10
23	P/O TWISTED PAIR WITH PIN 11
24	ISOLATED DIGITAL GROUND

THESE PINS  
ARE  
INTERNALLY  
GROUNDED

The 5344A contains metric threaded HP-IB cable mounting studs as opposed to English threads. Metric threaded HP 10833A, B, C, or D HP-IB cable lockscrows must be used to secure the cable to the instrument. Identification of the two types of mounting studs and lockscrows is made by their color. English threaded fasteners are colored silver and metric threaded fasteners are colored black. DO NOT mate silver and black fasteners to each other or the threads of either or both will be destroyed. Metric threaded HP-IB cable hardware illustrations and part numbers follow.



#### Logic Levels

The Hewlett-Packard Interface Bus logic levels are TTL compatible, i.e., the true (1) state is 0.0V dc to 0.4V dc and the false (0) state is +2.5V dc to +4.0V dc.

#### Programming

Refer to Section III, Operation

#### Mating Connector

HP 1251-0293; Amphenol 57-30240.

#### Mating Cables Available

- HP 10833A, 1 metre (3.28 ft.)
- HP 10833B, 2 metres (6.56 ft.)
- HP 10833C, 4 metres (13.12 ft.)
- HP 10833D, 0.5 metre (1.64 ft.)

#### Cabling Restrictions for Standard System

1. A Hewlett-Packard Interface Bus System may contain no more than 1.8 metres (6 ft.) of connecting cable per instrument.
2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus System is 20.0 metres (65.6 ft.).

Figure 2-5. Hewlett-Packard Interface Bus Connections



## **2-32. Operational Check**

2-33. To determine if the instrument is operating properly, refer to the operational verification in Section IV. Contact your nearest HP Sales and Support Office (see manual back cover) for information concerning warranty claims.

## **2-34. PACKAGING FOR RESHIPMENT**

### **2-35. Original Packaging**

2-36. The same containers and materials used in factory packing can be obtained through the Hewlett-Packard Sales and Support Office listed at the rear of this manual.

2-37. Since the S342A/5343A Microwave Frequency Counter is an integral part of the 5344S System, the counter should be returned with the 5344A when service is required.

2-38. If the instrument is being returned to Hewlett-Packard for service, attach a tag indicating the type of service required, return address, model number, and full serial number. Mark the container FRAGILE to assure careful handling.

2-39. In any correspondence, refer to the instruments by model numbers and full serial numbers.

### **2-40. Other Packaging Methods**

2-41. If it becomes necessary to re-ship an instrument, good commercial packing should be used. Contract packaging companies in many cities can provide dependable custom packaging on short notice. The following general instructions should be followed when repackaging with commercially available materials.

- a. If shipping to a Hewlett-Packard Office or Center, attach a tag indicating the type of required, return address, model number, and full serial number.
- b. Wrap the instrument in heavy paper or plastic.
- c. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.
- d. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside the container. Protect the front panel with cardboard.
- e. Seal the shipping container securely.
- f. Mark the shipping container FRAGILE to assure careful handling.

## **2-42. STORAGE**

2-43. If the instrument is to be stored for an extended period of time, it should be enclosed in a clean, sealed container.





## SECTION III OPERATION AND PROGRAMMING

### 3-1. INTRODUCTION

3-2. This section contains descriptions of operating characteristics and modes, operating procedures, descriptions of the front and rear panel controls and indicators, and Hewlett-Packard Interface Bus (HP-IB) programming information.

3-3. The 5344A is a companion instrument for the 5342A or 5343A Microwave Frequency Counter. The operation of the 5342A/5343A Counter should be understood before attempting to operate the 5344S system. For complete information on the 5342A or 5343A Microwave Frequency Counters, refer to the Operating and Service Manuals for these instruments. When appropriate, the 5344A/S operating information is supplemented with 5342A/5343A operating information where necessary for clarity.

3-4. The 5344A Source Synchronizer in combination with either a 5342A or 5343A Microwave Frequency Counter allows phase locking of a signal source to any frequency (1 Hz resolution) in the high operating range of the counter used. The desired lock frequency is selected via the 5344A keyboard and the signal source must be set within the specified capture range of that frequency in order for the 5344A to achieve lock. This can be automatically achieved if the source is an HP 8350A or an HP 8620C with Option 011.

3-5. The counter is fed a sample of the source signal to be locked. The 5344A generates a correction signal for the signal source by comparing the phase of the down converted signal in the counter with an internal crystal controlled synthesizer. The synthesizer may be swept over narrow ranges (40 MHz maximum), and the signal source will follow remaining phase-locked. For wider sweeps with an 8620C or 8350A, the source may be locked at the start of the sweep and the correction voltage held constant throughout the rest of the sweep (Lock and Roll mode).

3-6. User interaction with the system is through the 5344A front panel, which contains a keyboard, 11-digit scratchpad display, and RPG (rotary-pulse-generator) knob. All 5344S functions except Auto Lock may be controlled remotely via HP-IB.

3-7. The 5344A is attached mechanically to the 5342A or 5343A counter and electrically to the counter's microprocessor bus, IF and 10 MHz outputs.

### 3-8. MODES OF OPERATION

3-9. The 5344S has four modes of operation. They are CW, CF/ $\Delta$ F, Start/Stop, and Lock/Roll. Each mode can be used in Manual Lock or Auto Lock, as described in the following paragraph.

### 3-10. MANUAL LOCK MODES

3-11. Manual Lock requires the signal source to be manually tuned to within capture range of the selected frequency. If the 5344S is used with an 8350A or 8620C with Option 011, the 5344S can automatically tune the sweeper to the selected frequency (Auto Lock.)

### 3-12. CW in Manual Lock

3-13. The 5344S attempts to lock the signal source to the selected Continuous Wave (CW) frequency. If the signal source is too far from the desired frequency for the 5344S to bring it into lock, the FREQ HI or FREQ LO annunciator is turned on, and the signal source must be manually tuned (as indicated). When lock is achieved, the LOCKED annunciator lights. If lock is lost, the 5344A turns off the LOCKED annunciator and again indicates FREQ HI or FREQ LO.

### 3-14. CF/ $\Delta$ F in Manual Lock

3-15. The 5344S attempts to achieve a locked sweep of the signal source from:

$$\text{Center Freq} - \frac{\Delta \text{Freq}}{2} \quad \text{to} \quad \text{Center Freq} + \frac{\Delta \text{Freq}}{2}$$

using the SWEEP TIME selected by the user. If the signal source is too far from the desired frequency range, it must be manually tuned (as in CW mode). When lock is achieved, the LOCKED annunciator is lit. If lock is lost, the 5344S turns off the LOCKED annunciator, and the signal source must be manually tuned to regain lock. The sweep must not cross 500 MHz, 650 MHz, or 800 MHz, as described in paragraph 3-50.

#### NOTE

If  $\Delta F = 0$ , CF/ $\Delta F$  operates the same as the CW mode since the sweep width ( $\Delta F$ ) = 0.

3-16. In CF/ $\Delta F$  the 5344S can generate 4 separate markers over the sweep range. Discussion of markers begins in paragraph 3-43.

### 3-17. Start/Stop in Manual Lock

3-18. The 5344S attempts to achieve a locked sweep of the signal source from the selected START frequency to the selected STOP frequency using the SWEEP TIME selected by the user. If the STOP frequency is less than START, or STOP-START is too large, an error indication is given, and the locking process is restarted. If the signal source is too far from the desired frequency range, the signal source must be tuned (as in CW mode). The capture range, however, is reduced by 1/2. When lock is achieved, the LOCKED annunciator is lit. If lock is lost, the 5344S turns off the LOCKED annunciator, and the signal source must be manually tuned to regain lock. The sweep must not cross 500 MHz, 650 MHz, or 800 MHz, as described in paragraph 3-50.

#### NOTE

If START = STOP, START/STOP operates the same as the CW mode since the sweep width = 0.

3-19. In Start/Stop, the 5344S can generate 4 separate markers over the sweep range. Discussion of markers begins in paragraph 3-43.

### 3-20. Lock/Roll in Manual Lock

3-21. In the Lock/Roll mode, the 5344S has the ability to provide a highly accurate locked starting frequency and then uses the sweeper's ability to sweep wide frequency ranges. This combination gives significantly better accuracy for broad sweeps than a sweeper alone.





3-22. The 5344S attempts to lock the signal source to the selected Lock/Roll 5start frequency in the same manner as for CW Manual Lock operation. If successful, the 5344S holds the FM correction signal constant and sends a sweep trigger signal to the sweeper to start the sweep. It then waits for an end-of-sweep signal (derived from the sweeper's SWEEP OUT-10 volt ramp) and repeats the lock/trigger/wait cycle. The sweeper controls must be set properly to achieve the desired sweep from the locked starting frequency. In Lock/Roll mode, the LOCKED light is lit continuously even though the signal is only locked at the start of each sweep.

### **3-23. AUTO LOCK MODES (SYSTEM CONTROLLER)**

3-24. The 5344A contains a portion of the HP-IB code set for the 8350A and 8620C Sweep Oscillators. This gives the 5344S the ability to program many of these sweeper functions as if it were a controller (by IEEE 488-1978 terminology the 5344S is a System Controller). For instance if the CW frequency selected on the 5344A front panel is 10 GHz, the 5344A would automatically program the sweeper to a CW frequency of 10 GHz, provided the sweeper's RF Plug-in has that range. Paragraph 3-177, System Controller Mode, gives the IEEE 488-1978 details concerning this feature. The following paragraphs describe the basic operation of Auto Lock.

#### **NOTE**

Since the 8620C cannot be programmed for specific frequencies in the 5start/Stop mode, the 8620C cannot be used in Auto Lock/Roll.

### **3-25. CW in Auto Lock**

3-26. The 5344S attempts to lock the signal source to the selected CW frequency. If the signal source is too far from the desired frequency, the 5344S tunes the sweeper via HP-IB to bring it into lock. When lock is achieved, the LOCKED annunciator is turned on. If lock is lost, or cannot be achieved, the 5344S turns off the LOCKED annunciator and attempts to adjust the signal source via HP-IB to regain lock. If the signal source cannot attain the desired frequency, an error indication is displayed on the 5344A.

### **3-27. CF/ $\Delta$ F in Auto Lock**

3-28. The 5344S attempts to achieve a locked sweep of the signal source from the selected CF -  $\Delta$ F/2 to CF +  $\Delta$ F/2 using the SWEEP TIME selected by the user. If the signal source is too far from the desired frequency range, the 5344S tunes it via HP-IB (as in CW mode). When lock is achieved, the LOCKED annunciator is turned on. If lock is lost, the 5344S turns off the LOCKED annunciator and attempts to adjust the signal source via HP-IB to regain lock. If the signal source cannot attain the desired frequency, an error indication is displayed on the 5344A. The sweep must not cross 500 MHz, 650 MHz, or 800 MHz, as described in paragraph 3-50.

3-29. A marker signal is generated for any 5344S marker frequencies selected as described in paragraph 3-45.

### **3-30. Start/Stop in Auto Lock**

3-31. The 5344S attempts to achieve a locked sweep of the signal source from the selected START to the selected 5STOP frequency using SWEEP TIME selected by the user. If the STOP frequency is less than START, or STOP - START is too large, an error indication is displayed on the 5344A. If the signal source is too far from the desired frequency range, the 5344S tunes it via HP-IB (as in CW mode). When lock is achieved, the LOCKED annunciator is turned on. If lock is lost, the 5344S turns off the LOCKED annunciator and attempts to adjust the signal source via HP-IB to regain lock. If the signal source cannot attain the desired frequency, an error indication is displayed on the 5344A. The sweep must not cross 500 MHz, 650 MHz, or 800 MHz, as described in paragraph 3-50.

3-32. A marker signal is generated for any 5344S marker frequencies selected as described in paragraph 3-45.

### 3-33. Lock/Roll in Auto Lock

3-34. The 5344S attempts to lock the signal source to the selected Lock/Roll Start frequency in the same manner as for CW Auto Lock. If successful, the 5344A holds the FM correction signal constant and sends a sweep trigger signal to the sweeper to start the sweep. It then waits for an end-of-sweep signal (derived from the sweeper's SWEEP OUT-10V RAMP) and repeats the lock/trigger/wait cycle. The sweeper controls must be properly set to achieve the desired sweep from the locked starting frequency. The 5344S only sets the sweeper close to the desired starting frequency via HP-IB in this mode.

3-35. Auto Lock/Roll will operate only with the 8350A Sweep Oscillator.

3-36. In Lock/Roll, the signal is locked only briefly at the start of each sweep. It is possible for the sweeper settings to be changed during the unlocked portion of the sweep such that the starting frequency is changed by some near multiple of the selected 5342A/43A local oscillator frequency. This would result in lock being regained at the end of the selected sweep, even though the frequency is nowhere near that desired (pressing Reset causes the 5344S to re-lock to the desired frequency). In Lock/Roll, the LOCKED light is normally lit continuously even though the signal is only locked at the start of each sweep.

### 3-37. LOCKED SWEEPS CF/ $\Delta$ F and START/STOP

#### 3-38. Sweep Time for Locked Sweeps

3-39. Sweep time can be selected for the two Locked Sweep modes, CF/ $\Delta$ F and Start/Stop. The sweep time range is 10 ms to 100 s. The sweep mode may be Single or Continuous as determined by the ACQUIRE key (refer to under Front Panel Features, paragraph 3-102).

#### 3-40. Sweep Increment

3-41. During locked sweeps (CF/ $\Delta$ F and START/STOP modes) the 5344S is actually stepping the signal source to a new locked CW frequency every 10 microseconds in phase continuous steps. Normally the step increment is so small that the sweep appears to be continuous. The actual increment is given by the following formula (for START/STOP mode use START-STOP in place of  $\Delta$ F):

$$\text{INCR} = \frac{\Delta F}{\text{SWEEP TIME}/10 \mu\text{s}}$$

3-42. For example, if  $\Delta F = 40$  MHz and SWEEP TIME = 10 ms, INCR = 40 KHz. A fixed increment of 80 KHz is used for locked sweep retrace.

### 3-43. MARKERS

3-44. The 5344A has the ability to generate 4 separate markers. The markers are settable across the swept band. The following paragraphs describe the use of these markers.

3-45. Markers are generated by the 5344S only in CF/ $\Delta$ F and START/STOP modes. A marker signal is then generated for desired 5344S marker frequencies in the swept range. The markers can be disabled by setting them to 0, as described in Front Panel Features, paragraph 3-102. Setting any Marker below 500 MHz causes that marker to default to 500 MHz. Setting any marker above 18 GHz (5342A) or above 26.5 GHz (5343A) causes that marker to default to 18 GHz or 26.5 GHz. If the 5344S is in Subharmonic Mode or Frequency Offset Locking, the limits are 10 MHz to 99.99999999 GHz.

3-46. Markers cannot be arbitrarily close to each other or to the Start or Stop frequencies of the sweep. The determining factor is time, so, for slower sweeps, the markers can be closer in frequency. The minimum separation of the first marker and the start frequency is given by:

$$\frac{(40 \mu s) (STOP - START)}{SWEEP TIME}$$

3-47. The minimum marker spacing or the spacing between the last marker and the stop frequency is given by:

$$\frac{(1.4 \mu s) (STOP - START)}{SWEEP TIME}$$

3-48. If markers are entered that are too close to each other or the stop frequency, the S344A displays an error message while sweeping and ignores the offending marker(s). If the first marker is too close to the start frequency, the marker is ignored, but no error message is displayed.

3-49. The marker output is a -5V rectangular pulse at the Z AXIS OUT connector on the front panel.

### 3-50. Frequency Restrictions of Locked Sweeps

3-51. Due to IF bandwidth restrictions, locked sweeps (CF/ $\Delta F$  and START/STOP modes) cannot cross the frequencies of 500, 650 or 800 MHz. An error message is displayed if such a sweep is attempted.

## 3-52. SUBHARMONIC LOCKING AND FREQUENCY OFFSET LOCKING MODES

### 3-53. Subharmonic Locking Mode Overview

3-54. Subharmonic Locking Mode provides several benefits. They are:

1. Allows the front panel RF OUT to be used at its full power capabilities. No power splitters or directional couplers are necessary.
2. The ability to operate the S344S beyond the limits of 18 GHz (S342A) or 26.5 GHz (S343A). In this mode the maximum frequency is 99.99999999 GHz.
3. The RF OUT signal may be amplitude modulated (as required for network analyzers) without affecting the performance of the S344S.

3-55. These benefits are described in more detail beginning in paragraph 3-74.

### 3-56. Frequency Offset Locking Overview

3-57. Frequency Offset Locking mode is similar to Subharmonic Locking mode in that the 5344S phaselocks at a frequency that is offset from the entered frequency (instead of at a sub-harmonic of the input frequency). The lower limit for this mode is 10 MHz. Frequency Offset Locking mode is active whenever a frequency offset is entered in the S342A/43A, and the 5344S is in Subharmonic Locking mode, as described in Figure 3-18. The offset used by the 5344S is the negative of that entered in the counter and is applied to all frequencies entered into the 5344S except  $\Delta F$  and STEP SIZE.

3-58. To understand the operation of these modes, a basic description of the 83500 and 86200 series plug-ins is provided in the following paragraphs.

### 3-59. HEWLETT-PACKARD RF PLUG-INS

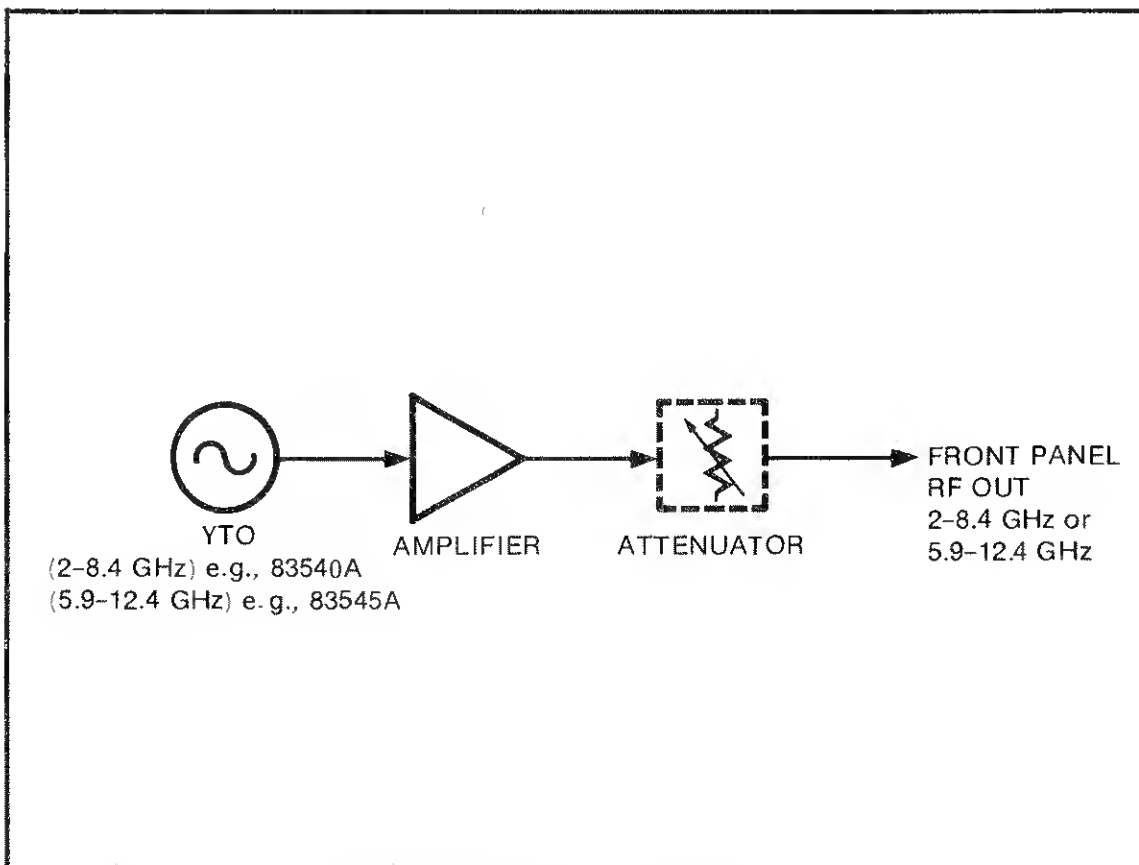
3-60. Most Hewlett-Packard 86200 and 83500 series sweeper plug-ins use one of the following techniques to generate the output signal.

1. Yttrium-Iron-Garnet (YIG) Tuned Oscillator (YTO)
2. YTO and fixed frequency Cavity Oscillator
3. YTO and a GaAs FET Doubler
4. YTO and a YIG Tuned Multiplier (YTM)
5. A combination of the above

3-61. The following paragraphs provide descriptions of typical plug-ins, and describe basic block diagrams. The blocks indicate specific plug-ins that use a technique, but certain sections of the block are deleted.

#### 3-62. Basic YTO

3-63. The basic YTO plug-in, as shown in *Figure 3-1*, generates frequencies over a single band. The YTO is voltage controlled over (for example), the range of 5.9 GHz to 12.4 GHz. The YTO output is fed to the front panel of the plug-in, possibly through an amplifier, as the RF OUT. An FM input on the rear panel allows external voltages to be used to vary the YTO frequency over a small range.



*Figure 3-1. Basic YIG Tuned Oscillator*

### 3-64. Basic YTO and Fixed Frequency Cavity Oscillator

3-65. To generate frequencies below the YTO's frequency range, the output of the YTO is mixed with a fixed frequency Cavity Oscillator, as shown in Figure 3-2. The difference frequency between the YTO and the Cavity Oscillator is fed to the front panel as the RF OUT. For example, the Cavity Oscillator is fixed at 3.8 GHz, and the YTO is tunable from 3.81 GHz to 6.2 GHz. When the YTO frequency is varied over its 3.81 GHz to 6.2 GHz range, the difference frequency moves from 10 MHz ( $3.81 \text{ GHz} - 3.8 \text{ GHz}$ ) to 2.4 GHz ( $6.2 \text{ GHz} - 3.8 \text{ GHz}$ ). The YTO output is fed to the rear panel as the AUX OUT. This plug-in would be specified with an output range of .01 GHz to 2.4 GHz even though the 3.81 GHz to 6.2 GHz signal is available at the rear panel AUX OUT. The front panel RF OUT is offset from the rear panel AUX OUT by a constant 3.8 GHz. Also located on the rear panel is an FM input to allow the YTO frequency to be varied over a small range. The stability and accuracy of this technique is limited by the stability of the YTO. However, when this plug-in is locked by the 5344S, the Cavity Oscillator becomes the limit of the stability and accuracy.

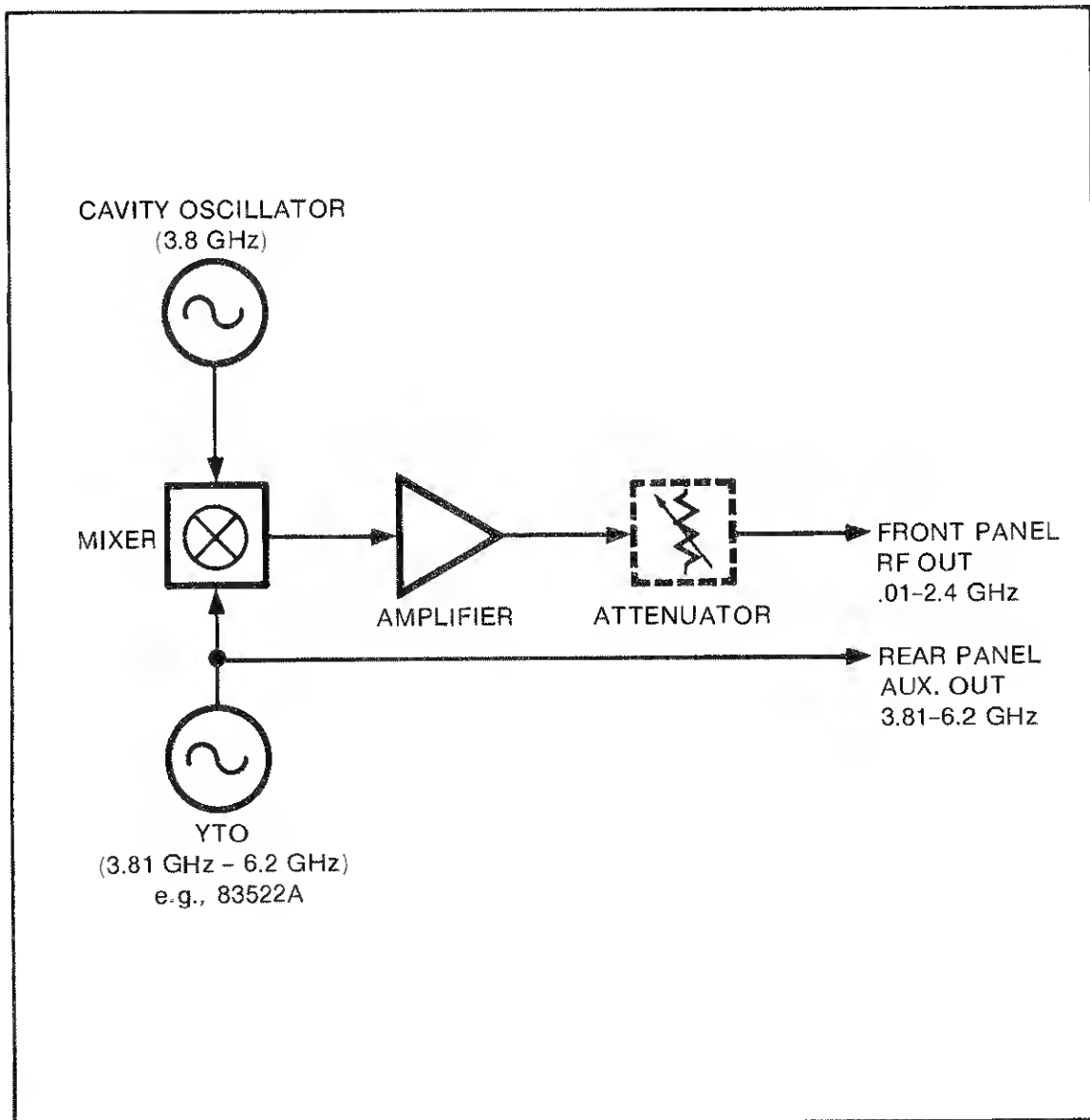


Figure 3-2. Basic YTO and Fixed Frequency Cavity Oscillator

### 3-66. YTO and GaAs FET Doubler

3-67. A simple way of generating frequencies above the YTO frequency range is to apply the YTO output (9-13.25 GHz) to a GaAs FET Doubler, as shown in *Figure 3-3*. As implied by its name, the doubler multiplies the YTO frequency by a factor of 2. By varying the YTO frequency, a range of 18 GHz to 26.5 GHz can be generated. The doubled signal is fed to the front panel as the RF OUT. The YTO signal is fed to the rear panel as the AUX OUT. The AUX OUT signal is always 1/2 of the YTO frequency. The rear panel FM input allows the YTO frequency to be varied over a small range. The stability of this technique is limited by the stability of the YTO.

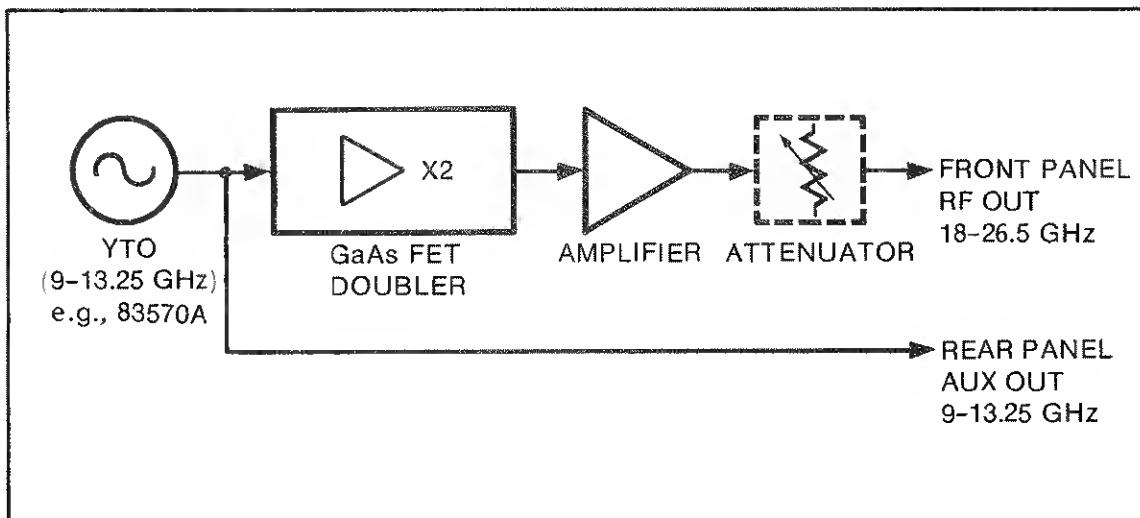


Figure 3-3. YIG Tuned Oscillator and GaAs FET Doubler

### 3-68. YTO and YTM

3-69. To generate frequencies above the YTO's frequency range, the output of the YTO is applied to a YIG Tuned Multiplier, as shown in *Figure 3-4*. The YTM multiplies the YTO output in integer steps (2 & 3). By varying the YTO frequency and the YTM value, a range of 2 GHz to 18.6 GHz can be generated. The multiplier output from the YTM is fed to the front panel as RF OUT. The YTO is fed to the rear panel as the AUX OUT. Also located on the rear panel is an FM input to allow the YTO frequency to be varied over a small range. The rear panel AUX OUT (YTO) is always a subharmonic of the front panel RF OUT (except when generating the 2 GHz to 6.2 GHz range. In this case the RF OUT and AUX OUT frequencies are equal). The stability of the technique is limited by the stability of the YTO.

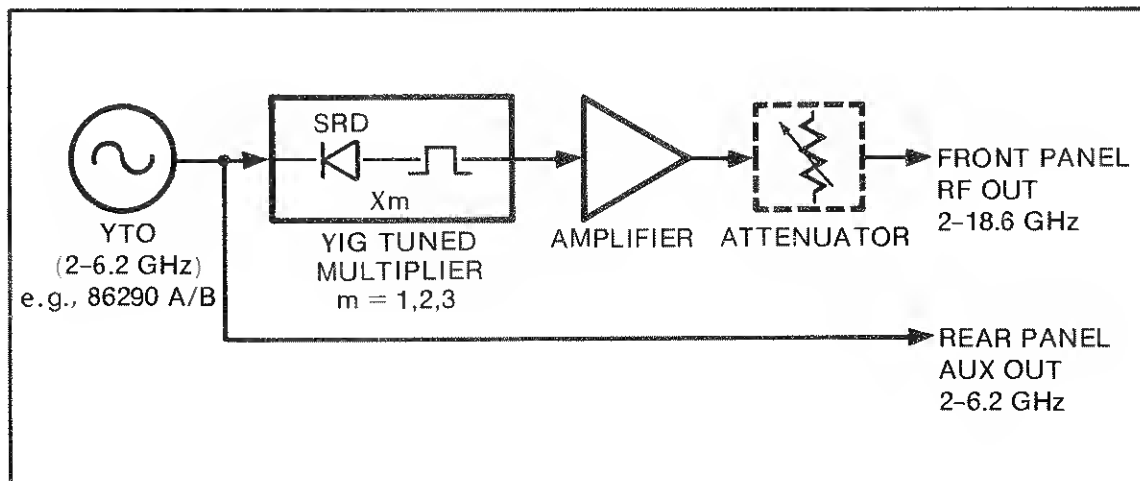


Figure 3-4. YTO and YTM

### 3-70. Wide Band Plug-ins

3-71. To generate wide-band frequencies, for example, .01 to 20.0 GHz, all of the previous techniques can be combined in one unit as shown in *Figure 3-5*. To generate frequencies below the YTO range, it is mixed with a fixed frequency Cavity Oscillator. To generate frequencies above the YTO range, it may be multiplied by a YTM.

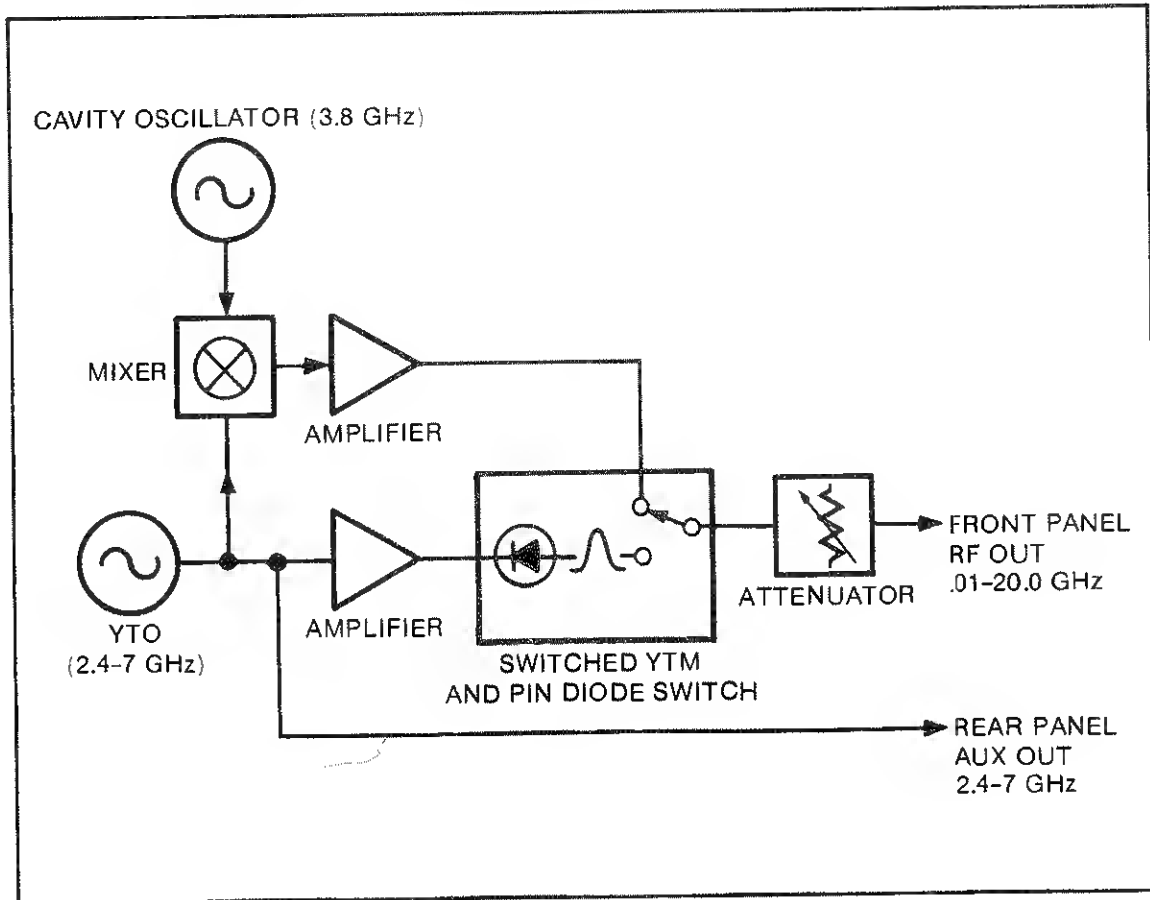


Figure 3-5. Wide Band Plug-in

3-72. Further investigation of the particular plug-in in use is suggested to help realize the full potential of the 5344S. Keep in mind the relationship between the RF OUT and the AUX OUT.

3-73. Subharmonic Locking and Frequency Offset Locking utilize these functions to expand the 5344S's capabilities.

### 3-74. Detailed Description of Subharmonic Locking Mode

3-75. Subharmonic mode provides a way to control sweeper plug-ins without having to place a power splitter or directional coupler in the signal path, which lowers the total available power and reduces flatness of the frequency response. Subharmonic Locking Mode also provides a way to control sweeper plug-ins that can generate frequencies beyond the 5344S's range.

3-76. In Subharmonic Locking Mode, instead of counting the front panel sweeper RF OUT to determine the necessary correction voltage, the 5344S counts the rear panel AUX OUT (YIG output). This AUX OUT is directly related to the front panel RF OUT, being either a subharmonic or offset by a specific value. This allows the front panel RF OUT to be used at its full power capabilities. Subharmonic Locking Mode cannot be used if the YIG output signal is not available before any multiplication, heterodyning, or modulation.

3-77. In Subharmonic Locking Mode, the AUX OUT (YIG fundamental) is applied to the counter input. Then the rear panel SUB HMNC/NORM switch is placed in the SUB HMNC position. This performs two functions: (1) enables the use of a Frequency Multiplier number, and (2) extends the 5344A's upper and lower numeric input limits. Frequencies not equal to the front RF OUT (but harmonically related) and frequencies above 18 GHz (5342A) or 26.5 GHz (5343A) can be entered. The 5344S compares the entered frequency on the 5344A to the frequency being applied to the counter, and determines the Frequency Multiplier number required, provided this number is within the range of 1 to 4. If the Frequency Multiplier number required is greater than 4, it must be entered manually. The highest allowable value is 99. See Frequency Multiplier, paragraph 3-89.

3-78. For example, the YIG is tuned to 5.0 GHz (at AUX OUT), but 20 GHz has been selected on the 5344A front panel. The 5344A determines the Frequency Multiplier number to be 4. The 5.0 GHz signal being applied to the 5342A is well within the 18 GHz limit.

3-79. However, if the selected value on the 5344A is 25 GHz, the 5344A will display Err 09, since the multiplier is 5, and the 5344A cannot automatically determine this. The multiplier of 5 must be manually entered. See Frequency Multiplier, paragraph 3-89.

### **3-80. Detailed Frequency Offset Locking**

3-81. Frequency Offset Locking allows the 5344S to operate with sweeper plug-ins that can generate signals below the 5344S's lower limit of 500 MHz. In this mode, the 5344S can control plug-ins down to 10 MHz. In the following example, the range of the plug-in is 10 MHz to 2.4 GHz. This range is generated using the YTO and Fixed Frequency Oscillator (Cavity Oscillator) described in paragraph 3-64.

3-82. Instead of applying the front panel RF output of the plug-in to the 5344S's counter input, the rear panel AUX OUT (YTO) is used. The AUX OUT is always 3.8 GHz higher (offset) than the front panel RF OUT. The YTO range is from 3.81 to 6.2 GHz. As can be seen, this range is above the counter's 500 MHz lower limit. Since the offset is constant, the 3.8 GHz can be subtracted from the counter's display. The display will now always be equal to the plug-in's front panel RF OUT.

3-83. The 5344S controls the plug-in over the range of 3.81 to 6.2 GHz. The YTO is being mixed with the Cavity Oscillator to generate a lower frequency. The Cavity Oscillator frequency (3.8 GHz) being subtracted from the counter's display is for user convenience only. This ensures the 5344S display and the counter's display are consistent.

3-84. The offset is not subtracted from the counter's display under the following conditions:

1. Manual or Auto Lock is off.
2. Manual or Auto Lock is on but the 5344S is out of lock.

3-85. Under these conditions, the counter will display the actual rear panel AUX OUT (YTO) frequency.

3-86. The rear panel MODE switch must be in the SUB HMNC position.

3-87. Since the Cavity Oscillator is not being controlled, any variation in the Cavity Oscillator's frequency is directly reflected in the plug-in's front panel RF OUT.





3-88. Some plug-ins, such as those described in paragraph 3-70, combined several techniques to generate signals over a wide range. The plug-in changes techniques at some frequency, for example, above 2.4 GHz. If the 5344S is being used in Frequency Offset Mode and a frequency is entered above the frequency where the Cavity Oscillator technique is used, the relationship between the AUX OUT and the RF OUT will no longer be an offset, but instead could be equal or a subharmonic. The offset entered into the counter is no longer needed. The offset will cause tuning to be very difficult, if not impossible.

### 3-89. Frequency Multiplier

3-90. If a Frequency Multiplier of "1" has been entered and Subharmonic Locking mode is enabled, the 5344S calculates an internal subharmonic integer by dividing the entered locking frequency by the selected signal source frequency as measured by the 5342A/43A. If this result is close to an integer (typically 10%), the 5344A rounds it and uses it as the Frequency Multiplier. If the 5344A determines the Frequency Multiplier to be greater than "4", it will display Err 09 indicating that it cannot determine the multiplier and the correct value must be manually entered.

3-91. To manually enter a Frequency Multiplier, Marker 9 is selected and then the multiplier is entered and terminated by pressing any one of the unit keys (GHz/s, MHz/ms).

3-92. The Frequency Multiplier number is applied to all frequencies entered into the 5344A except for  $\Delta F$  and Step Size.

### 3-93. MODE Switch (NORM/SUBHMNC on Rear Panel)

3-94. Since there is a possibility of locking to the wrong frequency if the sweeper is mistuned, a switch is provided to disable the Subharmonic Locking mode. The switch should be set to NORM if:

1. The plug-in does not use frequency multiplication.
2. The plug-in uses frequency multiplication, but the 5342A/43A is connected to the panel RF output.
3. There is a desire to utilize the subharmonic signal, but you prefer to enter the sub-harmonic frequency on the 5344A rather than the actual sweeper output frequency.

3-95. The position of the MODE switch is indicated by the rightmost decimal point of the numeric display. It is lit when subharmonic locking is in effect (SUB HMNC position) of MODE switch.

3-96. Since the 5342A/43A counter display is produced by multiplying the counted subharmonic signal (1 Hz resolution) by the harmonic number N, its resolution is only  $N \cdot \text{Hz}$ . The 5344S synthesizer's resolution is .01 Hz, so the actual locked sweeper output frequency resolution is still 1 Hz, regardless of harmonic number.

3-97. When in REMOTE (HP-IB) operation, the 5344A LOOP BANDWIDTH and Subharmonic Locking MODE switches are ignored. These functions are controlled via HP-IB commands until REMOTE mode is terminated. See paragraph 3-138.

### 3-98. PARAMETER LIMITS

3-99. Table 3-1 lists the absolute parameter limits for the 5344S.

Table 3-1. Parameter Limits

Mode	Parameter Limit	
	5342A	5343A
CW	500 MHz - 18 GHz	500 MHz - 26.5 GHz
CF $\Delta F$	500 MHz - 18 GHz 0 MHz - 40 MHz	500 MHz - 26.5 GHz 0 MHz - 40 MHz
START STOP	500 MHz - 18 GHz 500 MHz - 18 GHz	500 MHz - 26.5 GHz 500 MHz - 26.5 GHz
L/R (Start)	500 MHz - 18 GHz	500 MHz - 26.5 GHz
MARKERS	500 MHz - 18 GHz      500 MHz - 26.5 GHz Setting any Marker to 0 turns that Marker off	
SWEEP TIME	10 ms - 100 s	
STEP SIZE	0 Hz - 18 GHz	0 Hz - 26.5 GHz
FREQ. MULT.	1 - 99	

### 3-100. LOCKED MODE RESTRICTIONS

3-101. When LOCK mode is entered, the conditions listed in Tables 3-2 and 3-3 must be met:

Table 3-2. Manual Lock Mode Restrictions

Mode	Manual Lock Mode Restrictions	
	5342A	5343A
CW	None	None
CF/ $\Delta F$	$CF - \Delta F/2 \geq 500 \text{ MHz}$	$CF - \Delta F/2 \geq 500 \text{ MHz}$
START/STOP	$START \leq STOP$ $STOP - START \leq 40 \text{ MHz}$	$START \leq STOP$ $STOP - START \leq 40 \text{ MHz}$
LK/R	None	None
MARKERS	None	None
SWEEP TIME	None	None

Table 3-3. Auto Lock Mode Restrictions

Mode	Auto Lock Restrictions	
	5342A	5343A
CW	Frequency in Signal Source Range	
CF/ $\Delta F$	$CF - \Delta F/2 \geq 500 \text{ MHz}$ $CF - \Delta F/2$ and $CF + \Delta F/2$ in Signal Source Range	$CF - \Delta F/2 \geq 500 \text{ MHz}$
START/STOP	$START \leq STOP$ $STOP - START \leq 40 \text{ MHz}$ START and STOP in Signal Source Range	$START \leq STOP$ $STOP - START \leq 40 \text{ MHz}$
LK/R	LOCK/ROLL START Frequency in Signal Source Range	
MARKERS	None	None
SWEEP TIME	None	None

*Figure 3-6a*  
**FRONT PANEL FEATURES**

(See Page 3-14)

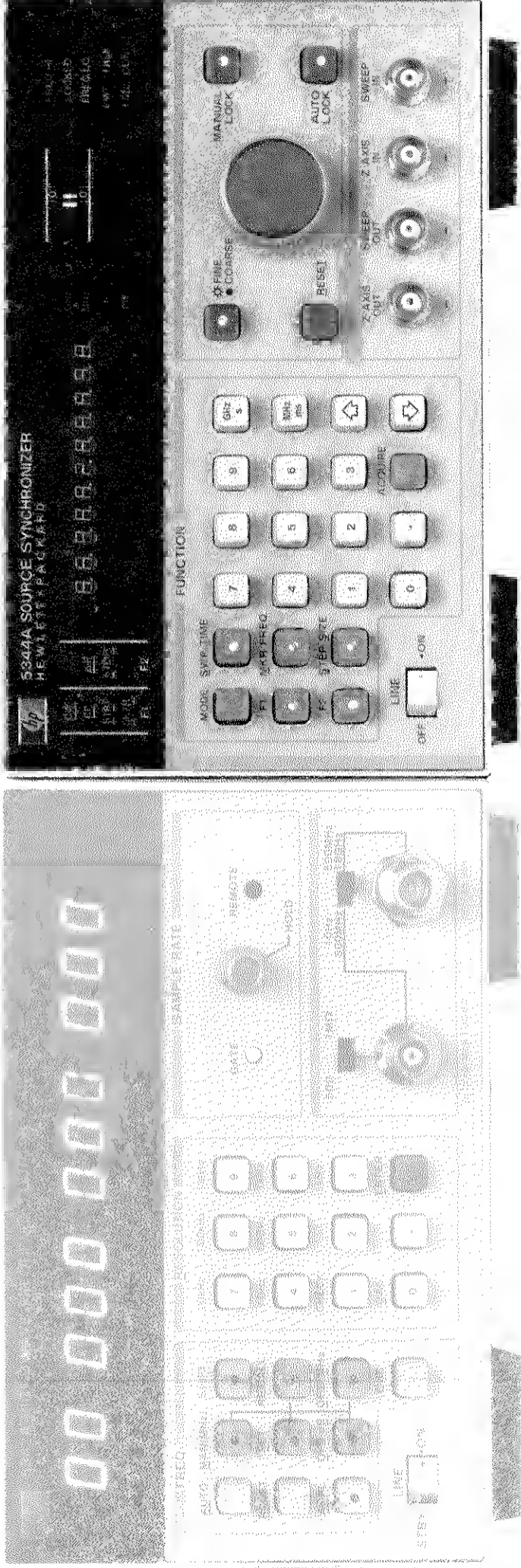


Figure 3-6a. Front Panel Features  
3-14

### 3-102. FRONT PANEL FEATURES

3-103. *Figure 3-6a* illustrates the 5344A front panel features. The function of each indicator and control is described as follows:

#### INDICATORS

##### Annunciators

##### CW

Indicates that the 5344S is in the CW (Continuous Wave) mode (single frequency; no sweep). The CW frequency is displayed and may be changed when the F1 key is lit.

##### CF/ΔF

Indicates that the 5344S is in CF/ΔF mode (frequency is swept from  $CF - \Delta F/2$  to  $CF + \Delta F/2$ ). The center frequency is displayed and may be changed when the F1 key is lit. The sweep width is displayed and may be changed when the F2 key is lit.

##### STRT STOP

Indicates that the 5344S is in START/STOP mode (frequency swept from START to STOP). The start frequency is displayed and may be changed when the F1 key is lit. The stop frequency is displayed and may be changed when the F2 key is lit.

##### LK/R

Indicates that the 5344S is in LOCK/ROLL mode (frequency locked at L/R START, then released to allow sweeper to control sweep). The starting lock frequency is displayed and may be changed when the F1 key is lit.

#### NOTE

The MODE key "scrolls" through the four modes listed above. When the MODE key is pressed, the mode changes from CW to CF/ΔF, CF/ΔF to START/STOP, START/STOP to LOCK/ROLL, LOCK/ROLL to CW. See MODE KEY.

As the mode changes, the previous frequency parameters are carried into the new mode:

$$\begin{aligned} CF &= CW & \Delta F &= STOP - START \\ START &= CF - \Delta F/2 & STOP &= CF + \Delta F/2 \\ L/R \text{ START} &= START \\ CW &= L/R \text{ START} + (STOP - START)/2 \end{aligned}$$

##### Display Digits

The 5344A display contains 11 digit positions. The display is used to show the value of the currently selected 5344S parameter. It is also used to indicate any error conditions arising during operation. The rightmost decimal point is used to indicate the position of the rear panel Mode switch. See paragraph 3-74. When the SWEEP TIME is selected, the characters S.S. appear on the display. See Sweep Time, paragraph 3-38.

##### GHz/MHz/S/ms

Indicates the units of the displayed value (gigahertz, megahertz, seconds, milliseconds).

##### Bar Meter

The meter (10 segment, center scale bar graph) indicates the frequency correction signal being applied to the signal source. It shows how close the source's uncorrected frequency is to that desired. The two center bars are dimly lit when the correction signal is near zero. As the signal moves from zero, the appropriate one of the two center bars switches to full intensity. As the signal continues to deviate from zero, successive bars light until full scale is reached. The direction the bar graph moves proportional to the voltage control FM input of the sweeper.



#### NOTE

The LOCKED, FREQ HI and FREQ LO indicators and the meter are not active unless the 5344S is in either MANUAL or AUTO LOCK mode. The METER is not active unless the 5344S is LOCKED and the LOCKED lamp is on.

#### FREQ HI/FREQ LO

When the input signal is not locked, these indicators show its position relative to the desired frequency. This information should be used to tune the signal source to achieve Manual Lock (see Manual Lock Mode Restrictions *Table 3-2*).

#### LOCKED

Indicates that the input signal of the 5342A/43A counter is locked to the frequency (CW or swept) entered on the 5344A keyboard.

#### RMT

When lit, shows that the 5344A has been selected for HP-IB programming. See Remote Programming Via the HP-IB, paragraph 3-138.

#### TALK/LSN

These indicators show the selected 5344A HP-IB status. The TALK light indicates that the 5344A is the selected Talker on the HP-IB. This occurs only during Auto Lock and serial polls when the 5344A is being accessed remotely. The LSN light indicates that the 5344A is currently addressed to listen on the HP-IB. This never occurs in Auto Lock mode.

#### CONT

The CONT light indicates that the 5344S is in the SYSTEM CONTROLLER mode (rear panel switch is in the SYS CONT position). With the switch in the SYS CONT position, the Auto Lock mode of the 5344S is enabled (See Auto Lock Key). No other HP-IB system controller can be on the bus when the 5344S is in this mode.

### CONTROLS

#### FUNCTION KEYS

##### MODE

MODE cycles (scrolls) through the mode selection (CW, CF/ $\Delta$ F, START/STOP, LOCK/ROLL). Each time the MODE key is pressed, the mode advances one function. The appropriate mode indicator is turned on, and the F1 key is lit. The 5344A parameter associated with F1 for the newly selected mode is displayed.

##### F1

Selects the first mode parameter (CW, CF, START, LOCK/ROLL START) for display/change.

##### F2

Selects the second mode parameter ( $\Delta$ F, STOP) for display change. F2 is ignored in CW mode and in LOCK/ROLL is used only to invoke a special diagnostics mode. See *Table 8-9* for diagnostics.

##### SWP TIME

Selects the SWEEP TIME parameter for display/change. When SWEEP TIME is selected, it may also be used to toggle the sweep mode between SINGLE and CONTINUOUS by pressing the ACQUIRE key. In CONTINUOUS sweep, the 5344S initiates a new sweep immediately after the previous sweep ends. In SINGLE sweep, the 5344S waits for RESET to be pressed or a change in any sweep parameter before initiating a sweep. SINGLE sweep sub-mode is indicated by S.S. being displayed in the two leftmost digit positions of the 5344A display whenever SWEEP TIME is selected.



#### NOTE

If the SWEEP TIME is greater than 50 seconds and  $\Delta F$  (or STOP-START) equals 1 Hz, the resultant sweep will be invalid.

### MKR FREQ

Selects the marker frequency parameters or the frequency multiplier for display/change. The next key pressed should be 1, 2, 3 or 4, specifying which of the four markers is to be selected; 0, specifying that all four markers are to be set to zero (disabled); or 9, specifying that the Frequency Multiplier is to be entered. The display is cleared when the MKR FREQ key is pressed and remains blank until a valid digit (0, 1-4, or 9) is entered. The MKR FREQ light (in the key) also flashes until a valid digit is entered.

When MKR FREQ 0 is entered, all four marker frequencies are immediately set to zero, thus disabling them. MKR FREQ 1 is then selected as the parameter.

Entering MKR FREQ 9 displays the selected frequency multiplier. A new multiplier may then be entered with the numeric digit keys. Entry of the multiplier is completed by pressing either units key (GHz/s or MHz/ms). The frequency multiplier must be an integer between 1 and 99. Any entered fraction will be truncated.

### STEP SIZE

Selects the STEP SIZE parameter for display/change.

#### Numeric Entry Keys: (0-9, ., GHz/s, MHz/ms)

One means of changing the currently selected parameter is to enter a new value with the numeric entry keys. The general sequence of keystrokes is as follows:

First digit or decimals (.) - Pressing the first numeric entry key results in clearing the 5344S display of the selected value of the selected parameter and entering the value of the new first digit or the decimal point in the most significant position (leftmost).

Subsequent digits or decimals (.) - Subsequent depression of a digit key results in the new digit being displayed on the right of the value entered previously. Pressing the decimal point key results in the decimal point appearing in the rightmost digit position of the value entered. Only one decimal point may be entered. Any others after the first are ignored. Also, only 11 digits may be entered. Additional digits will be ignored.

GHz/s, MHz/ms - One of the units keys must be pressed following entry of the numeric value. If the currently selected parameter is a frequency, the "GHz" or "MHz" light will be turned on. If the parameter is SWEEP TIME, the "s" or "ms" light will be turned on. If the parameter is FREQUENCY MULTIPLIER, neither light will be turned on.

The value of the selected parameter is updated, and if the 5344S is in LOCK mode (MANUAL or AUTO), the new parameter is immediately reflected in the lock operation.

#### NOTE

Depending on the parameter changed and the magnitude of the change during LOCK mode, the 5344S may or may not be able to regain lock. It will, however, remain in LOCK mode waiting for the user to adjust the signal source (MANUAL LOCK) or tune it via HP-IB (AUTO LOCK).

Also note that once numeric entry has begun (i.e. once the first digit or decimal point key has been pressed), the increment/decrement keys, the tuning knob, the ACQUIRE key, and the MANUAL and AUTO LOCK keys are ignored until the entry is complete or terminated. Numeric entry may be terminated without affecting the value of the currently selected parameter by pressing any function key (including the one currently lit).



#### ACQUIRE Key:

5344S frequency parameters may be changed by acquiring them from the 5342A/43A counter. This is accomplished by pressing ACQUIRE following the selection of the desired parameter. If the 5344S is not locked, an automatic measurement is performed on the 5342A/43A and the result entered in the 5344S display and used to update the selected parameter. If the 5344S is locked, the value of the F1 parameter of the selected mode is taken as the new parameter and is immediately reflected in the lock operation. Note that SWEEP TIME,  $\Delta F$ , and FREQUENCY MULTIPLIER may not be acquired. (When SWEEP TIME is selected, the ACQUIRE key is used to toggle the state of the sweep submode from CONTINUOUS to SINGLE or vice versa.)

#### Increment/Decrement Keys: (Up arrow , Down arrow )

Pressing the increment (or decrement) key results in the selected STEP SIZE being added to (or subtracted from) the currently selected parameter. The 5344S display is updated, and if the 5344S is in LOCK mode, the new parameter is immediately reflected in the lock operation. The increment and decrement keys may not be used to change SWEEP TIME or FREQUENCY MULTIPLIER.

#### Tuning Knob (RPG):

The tuning knob may also be used to adjust all 5344S parameters except FREQUENCY MULTIPLIER. Turning the knob clockwise increases the value of the parameter, and turning the knob counter-clockwise decreases the value. The 5344S display is updated, and, if the 5344S is in LOCK mode, the new value of the parameter is reflected immediately in the lock operation. The rate of change in the value being adjusted with the tuning knob is affected by the selected state of the FINE/COARSE key and the rate at which the knob is being turned.

#### FINE/COARSE Key

Pressing the FINE/COARSE key toggles the state of the FINE/COARSE indicator light (in the key). When the light is turned off, tuning knob adjustments are relatively coarse, allowing rapid changes in parameter values. When the light is on, adjustments are slower, allowing easier fine-tuning. The FINE/COARSE key is operational at any time except when the 5344S is in REMOTE HP-IB operation.

#### RESET Key:

The RESET key has three effects:

1. If the 5344S is in REMOTE HP-IB operation, the RESET key returns the 5344S to LOCAL mode, restoring control to the front panel. (Note that the RESET key is ignored if a "LOCAL LOCKOUT" HP-IB command has been received by the 5344A).
2. If the 5344S is in LOCK mode but not in REMOTE HP-IB operation, RESET restarts the locking algorithm.
3. If the 5344S is LOCKED, in a sweep mode (CF/ $\Delta F$ , START/STOP, LOCK/ROLL), and the single sweep sub-mode has been selected, pressing RESET initiates a new sweep.

#### MANUAL LOCK Key:

Pressing the MANUAL LOCK key when its light is off, places the 5344S in LOCK mode (or keeps it in LOCK mode if AUTO LOCK is already in effect) and indicates that the signal source may need to be tuned to achieve lock. Pressing the MANUAL LOCK key when its light is already on disables LOCK mode and turns off the MANUAL LOCK indicator light.



#### **AUTO LOCK Key:**

Pressing the AUTO LOCK key when its light is off, places the 5344S in LOCK mode (or keeps it in LOCK mode if MANUAL LOCK is already in effect) and indicates that the signal source will be tuned automatically by the 5344S via HP-IB as necessary to achieve lock. Pressing the AUTO LOCK key when its light is already on disables LOCK mode and turns off the AUTO LOCK light.

The "SYSTEM CONTROLLER" switch on the 5344S rear panel HP-IB address switch must be in the "SYS CONT." position when AUTO LOCK is pressed. Otherwise, an error indication will be given.

#### **NOTE**

If no valid frequency has been entered when LOCK mode is initiated for the first time, a measurement will be made on the 5342A/43A and the resulting frequency used by the 5344S for the selected mode's F1 parameter (CW, CF, START, LOCK/ROLL START).

### **CONNECTORS**

#### **Z AXIS OUT**

This connector provides a Z-axis modulation signal for display devices (oscilloscope, X-Y recorder). Provides a rectangular -5V pulse for selected marker frequencies. At all other times Z AXIS OUT is tied directly to Z AXIS IN. Z Axis Out is generated by the 5344S when locked in either locked sweep mode (CF/ $\Delta$ F or START/STOP).

#### **SWEEP OUT**

This connector provides a linear ramp voltage from zero to 10 volts synchronous with the RF sweep signal. Sweep Out is generated by the 5344S when locked in either locked sweep mode. At all other times, SWEEP OUT is tied directly to SWEEP IN.

#### **NOTE**

Z AXIS OUT and SWEEP OUT are not generated by the 5344S in CF/ $\Delta$ F mode if  $\Delta$ F=0 or in START/STOP mode if START = STOP.

#### **Z AXIS IN**

This connector accepts the Z-axis modulation signal from the sweeper. It is tied directly to Z AXIS OUT within the 5344S except when the 5344S is locked in a locked sweep mode. Then Z AXIS IN has no effect.

#### **SWEEP IN**

This connector accepts the SWEEP OUT signal from the sweeper. It is required in LOCK/ROLL mode to allow end-of-sweep detection and is then tied directly to SWEEP OUT within the 5344A. SWEEP IN is also tied to SWEEP OUT at all other times except when the 5344S is locked in a locked sweep mode (such as CW mode). Then SWEEP IN has no effect.

### **POWER**

#### **LINE OFF/ON**

This switch applies power to the 5344A. If the 5342A (or 5243A) is already on, the counter will go through its power-up routine following the 5344A power-up routine.



### 3-104. REAR PANEL FEATURES

3-105. *Figure 3-6b* illustrates the 5344A rear panel features. The function of each control is described as follows:

#### HP-IB Connector

Used to convey data and programming information. IEEE-1978 Compatible. See paragraph 3-138.

#### HP-IB ADDRESS Switches

The HP-IB address switch has seven individual switches, six of which are actually used. The top switch determines if the 5344S's AUTO LOCK mode may be invoked from the front panel. With the switch in the SYS CONT. position, the 5344S will act as an HP-IB system controller to set sweeper parameters via HP-IB when AUTO LOCK is pressed. No other system controller may be in a powered-up state on the bus if SYS CONT. is selected. When the top switch is not in the SYS CONT. position, the 5344S may be programmed remotely via HP-IB by any bus controller.

The bottom five switches are used to set an HP-IB address in binary (bottom switch is the LSB). HP-IB addresses must be in the range 0-30 (binary 0000 11110). If all of the address switches are in the "1" position, the 5344S will use address 30. If system controller mode is selected (top switch in SYS CONT. position), the HP-IB address switches should be set to the address of the sweeper to be controlled in AUTO LOCK. If system controller mode is disabled, the HP-IB address switches determine the address by which the 5344S is accessed on the bus by a remote controller. The unmarked switch is not used. Refer to paragraph 3-151. HP-IB Address Selection for more details.

#### FM OUT

This connector provides the frequency correction signal (FM) needed to maintain the locked frequency output of the signal source. It must be connected to the FM input of the signal source or locked operation.

#### SWP TRIG

This connector provides the signal necessary to control the sweeper in LOCK/ROLL mode. It must be connected to the EXT TRIGGER connector on the sweeper (or, optionally, STOP SWEEP on the 8350A).

#### IF IN

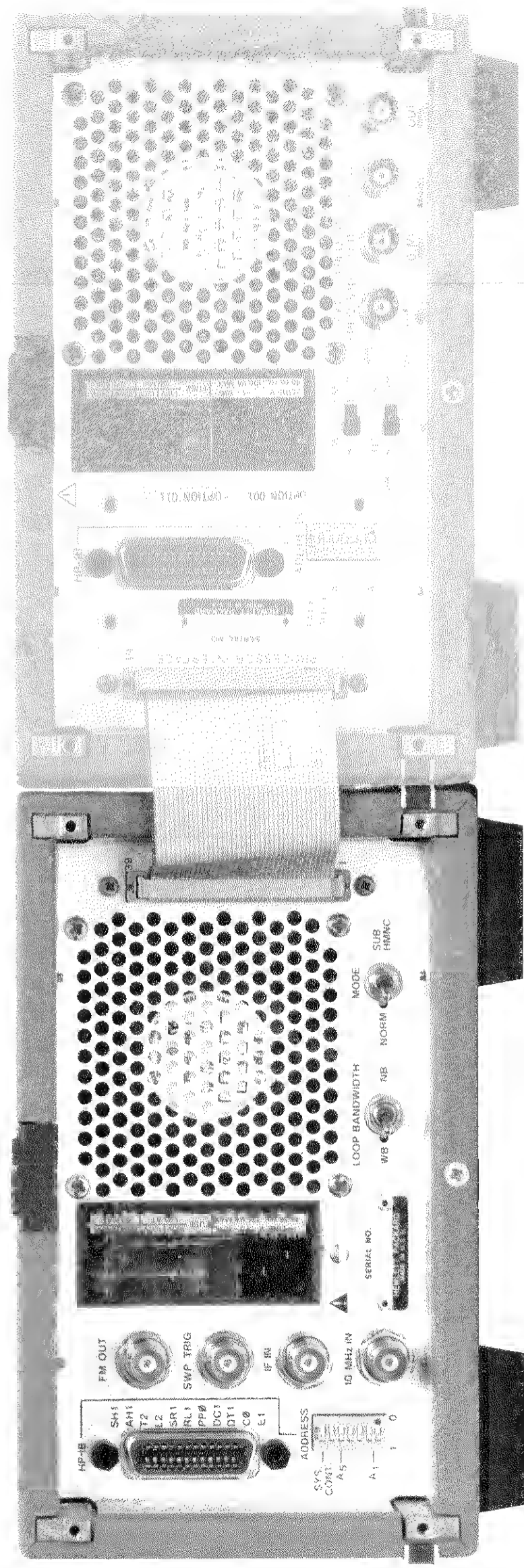
This connector must be connected to the IF OUT signal provided on the rear panel of the 5342A/43A.

#### 10 MHz IN

This connector must be connected to the FREQ STD OUT (10 MHz) signal provided on the rear panel of the 5342A/43A.

#### Input Power Module

AC input power module permits operation from 100-, 120-, 220-, 240- volts ac. The number visible in the module window indicates nominal line voltage to which the instrument must be connected (see *Figure 2-1*). The protective grounding conductor connects to the instrument through this module.



**REAR PANEL FEATURES**



### LOOP BANDWIDTH-WB/NB (WIDE BAND/NARROW BAND)

This switch sets locking loop bandwidth to about 100 kHz (WB), recommended for sweepers, or to about 20 kHz (NB), recommended for signal generators in CW mode only. The NB mode often yields better phase noise performance, but the WB mode is recommended to lock noisier sources (like sweepers) or any source when sweeping.

The position of the LOOP BANDWIDTH switch is indicated by the MANUAL or AUTO LOCK key light when in LOCK mode. If the switch is in the wideband (WB) position, the LOCK light is always on. In narrowband (NB), the light flashes slowly.

### SUBHMC/NORM (SUBHARMONIC/NORMAL) MODE Switch

This switch, when in the SUBHMC position, defeats the upper and lower frequency limits, and enables the use of a Frequency Multiplier. See paragraph 3-89.

### PROCESSOR INTERFACE Connector

Provides the electrical connections for the interface cable between the 5344A and the counter.

#### WARNING

ANY INTERRUPTION OF THE PROTECTIVE (GROUNDING) CONDUCTOR INSIDE OR OUTSIDE OF THE INSTRUMENT OR OR DISCONNECTING OF THE PROTECTIVE EARTH TERMINAL IS LIKELY TO MAKE THE INSTRUMENT DANGEROUS. (See paragraph 2-14.)

### 3-106. Function Key Operation

3-107. Pressing any FUNCTION key (Figure 3-6) results in termination of any other parameter display or change in progress. The indicator light in the previously selected function key is turned off. The light associated with the newly selected parameter is turned on, and the selected value of that parameter is displayed (except as mentioned for marker frequencies and the Frequency Multiplier, which require that a digit key also be pressed before the value can be displayed). Once the parameter is displayed, it can be changed via the Numeric Entry Keys (all parameters), Increment/Decrement keys (frequency parameters only except STEP SIZE), or the Tuning Knob (all parameters except FREQUENCY MULTIPLIER).

### 3-108. 5344A Display While Locked

3-109. In LOCK mode, the 5342A/43A front panel displays the following as listed in Table 3-4:

Table 3-4. 5344A Display While Locked

Mode	5342/5343A Display
CW	CW Frequency
CF/ $\Delta$ F	CF Frequency
START/STOP	Start Frequency
LOCK/ROLL	LOCK/ROLL START Frequency



3-110. In CW mode the 5342A/43A is actually counting the input frequency and updating the display. In CF/ $\Delta F$  and START/STOP modes the display is static. In LOCK/ROLL mode the display is also normally static, but if the counter being used with the 5344S is a 5343A and the signal source is an HP 8350A sweeper, the Counter Trigger mode may be invoked on the 8350A to momentarily stop the sweep and signal the 5344S to measure a desired frequency (stop or marker). The 8350A's CNTR TRIG output must be connected to the 5343A's SWP INTFC A input. The sweeper's STOP SWEEP input must be connected to the 5344A's SWEEP TRIGGER output or to the 5343A's SWP INTFC B. Then selecting a frequency parameter on the 8350A front panel and pressing the SHIFT and M2 keys enables Counter Trigger mode. See Figure 3-11 Lock/Roll in Manual or Figure 3-15, Lock/Roll in Auto Lock for a descriptive procedure.

### 3-111. OPERATOR'S CHECKS

#### 3-112. 5342A/5343A Stand-Alone Operation

3-113. The 5344A and the 5342A/43A each have power switches that must be set to the ON position. The order in which they are turned-on doesn't matter. The 5342A (or 5343A) may be operated alone by applying power only to the counter. However, since the 5344A uses the counter's microprocessor, if both instruments are ON and the 5344A is switched OFF, the 5342A must be switched OFF, then ON, to return complete control to the 5342A. This is not required with the 5343A.

#### 3-114. Power-Up Self Check

3-115. On power-up, the 5344S performs its self-test routine. If all tests pass, the 5344S performs its initialization and then passes control to the 5342A/43A which performs its own self-test and proceeds to free-run mode (5342A/43A counting; 5344A idle).

3-116. The power-up values for 5344S parameters are as shown in Table 3-5:

Table 3-5. 5344S Power-Up Parameters

MODE = CW
CW = STOP = START = 0
$\Delta F = 0$
MARKERS = 0
SWEEP TIME = 10 ms
STEP SIZE = 0
FREQUENCY MULTIPLIER = 1
LOCK = OFF
RPG KNOB = COARSE
HP-IB: LOCAL
RM = 0

3-117. If during the power-up self-test a failure is detected, an error code will be displayed on the 5344A as follows:

Err 13 ..... Ux ROM Failure  
Err 14 ..... RAM Failure

where x is the reference designation of the defective ROM located on the A11 Main ROM Buffer Assembly.

3-118. If one of these errors is displayed, refer to Section VIII, Service for further instructions.

### 3-119. ERRORS AND END OF SWEEP (----EOS----) MESSAGES

3-120. When an operational error is detected by the 5344S, such as an incorrect parameter, an error message is displayed on the 5344A front panel. The error message consists of "Err" followed by a two-digit error number. Table 3-6 describes each error condition and the probable causes for it.

Table 3-6. ERROR Messages

**Err 01. Invalid frequency measurement on 5344S.**

- a. Signal source output not connected to counter input.
- b. Source power level too low.
- c. Source RF OUT turned off.
- d. Source RF BLANKING turned on when using Lock/Roll mode on 5344S.
- e. Signal source frequency < 500 MHz or > 18 GHz (5342A) or 26.5 GHz (5343A).
- f. Signal source sweeping or being manually tuned too fast.
- g. Signal source internal square-wave modulation turned on.
- h. Cables are defective or not usable over desired frequency range.

**Err 02. Markers too close to each other or to the STOP frequency.**

Solution: Move markers or increase sweep time.

**Err 03. STOP frequency less than START frequency.**

**Err 04. STOP frequency - START frequency greater than 40 MHz.**

Solution: Reduce sweep span.

**Err 05. Signal source FM sensitivity less than 1 MHz/volt.**

- a. Sensitivity really is less than 1 MHz/volt.
- b. 5344A FM OUT not connected to signal source FM INPUT.
- c. For HP 86200 plug-ins: PL-NORM-FM switch in NORM position. (Should be in PL position).
- d. For HP 83500 plug-ins: CW filter enabled.
- e. 5344A A6 (Main Loop Board) fuse blown.

**Err 06. Signal source FM sensitivity greater than 100 MHz/volt.**

**Err 07. Sweep too wide for signal source sensitivity.**

Solution: Reduce sweep width.  
Increase source FM sensitivity.

**Err 08. Sweep cannot cross the frequencies of 500, 650 or 800 MHz.**

Solution: Change sweep parameters.

**Err 09. Invalid value calculated for Frequency Multiplier in Subharmonic Locking Mode.**

- a. Sweeper is not tuned close enough to desired frequency to allow reliable automatic determination of harmonic number.

Solution: Tune source closer to correct frequency.  
Use AUTO LOCK (System Controller).

- b. The 5344S has determined the harmonic number to be greater than four.

Solution: Enter the Frequency Multiplier manually.



Table 3-6. ERROR Messages (Continued)

<b>Err 10.</b>	System controller switch not set to SYS CONT for AUTO LOCK. (ADDRESS switch on rear panel.)
	Solution: Set switch to SYS. CONT. Use Manual Lock.
<b>Err 11.</b>	Signal source cannot be tuned close enough via HP-IB.
	a. Signal source HP-IB port not connected to 5344A.
	b. 5344A HP-IB address switch not set to address of signal source.
	c. Signal source is not HP 8620C or HP 8350A.
	d. Desired frequency is not within range of installed plug-in.
	e. 8620C has plug-in installed that is not supported for Auto Lock, (86210A, 86220A, 8621A/B).
<b>Err 12.</b>	AUTO LOCK cannot be achieved.
	a. AUTO LOCK attempted in LOCK/ROLL mode with 8620A/B/C sweeper.
	Solution: Use Manual Lock.
	b. HP-IB address of sweeper and 5344A are not the same.
<b>Err 13.</b>	Checksum error in power-up ROM test. Bad ROM number (U1, U4, U6, U8) also displayed.
<b>Err 14.</b>	RAM failure during power-up self-test.
<b>Err 15.</b>	Actual locking frequency out of range (500 MHz to 18 GHz for 5342A, or 500 MHz to 26.5 GHz for 5343A) in Subharmonic or Offset Locking mode.

### 3-121. End-of-Sweep (EOS) Message

3-122. The 5344A will display ----EOS---- when LOCK mode is entered or RESET is pressed, while waiting for the present sweep to be completed so that a locking sequence may be started. EOS is also displayed when the 5344S has triggered a sweep and is waiting for the sweeper to respond.

3-123. There are several possible causes for the EOS message to remain on the display of the 5344A:

- The sweeper is set for long sweep times, and the present sweep has not yet been completed.
- The SWEEP IN of the 5344A is not connected to the sweep ramp of the source.
- The sweeper is not sweeping.
- The sweeper's RF output is turned off for any length of time.
- The sweeper is tuned out of the capture range of the 5344S.
- The SWEEP TRIGGER out of the 5344S is not connected to the source.

### 3-124. SIGNAL SOURCE REQUIREMENTS

3-125. Signal sources to be used with 5344S must meet the following specifications:

- Frequency and output power which meet the 5344S specifications of *Table 1-1*.
- An FM port with a sensitivity between 1 and 50 MHz/volt and bandwidth of dc to at least 2 MHz in wideband mode, or dc to at least 200 KHz in narrowband mode. If the input impedance of the FM port is less than 5 Kohms, the sensitivity will be reduced by the output impedance of the 5344S FM OUT signal (250 ohms). The minimum sensitivity must then be  $(R_{in} + 250)/R_{in}$  MHz/Volt, with  $R_{in}$  in ohms. The FM input bandwidth must also meet the minimum values with this 250 ohms in series with it. This is significant only if the input capacitance is large.



**3-126. HP Signal Sources Used With the 5344S**

3-127. The HP sweeper mainframes listed in *Table 3-7* meet the requirements listed in paragraph 3-125 over at least part of their range.

**CAUTION**

**SEE PARAGRAPH 3-131 BEFORE CONNECTING THE 5344S TO THE 8640A/B. DAMAGE TO THE 8640A/B MAY RESULT IF A DIRECT CONNECTION IS MADE.**

*Table 3-7. HP Sweeper Mainframe/5344A Compatibility*

Sweeper Mainframe	Compatibility
8350A Sweeper	MANUAL and full AUTO LOCK
8620A/B Sweeper	MANUAL LOCK only
8620C Sweeper (without Option 011)	MANUAL LOCK only
8620C Sweeper (with Option 011) except for AUTO LOCK/ROLL	MANUAL and AUTO LOCK
8640A/B Signal Generator	MANUAL LOCK only
8683A/B Signal Generator }	Limited Capture Range
8684A/B Signal Generator }	and Sweep Width

### 3-128. HP Sweeper Plug-in/5344S Compatibility

3-129. Table 3-8 lists the compatibility of the various HP sweeper plug-ins for the 8350A and 8620A/B/C.

Table 3-8. HP Sweeper Plug-In/5344A Compatibility

Plug-In	Sweeper		*Restrictions/Comments
	8620	8350	
83522A		X	1
83525A		X	1
83540A		X	1
83545A		X	1
83570A		X	1
83590A		X	1
83592A		X	1
83594A		X	1
83595A		X	1
8621A/B	X		2
86222A/8	X	X	5
86222A/B-H80	X	X	3; MLA
86230A/8	X	X	5
86235A	X	X	5
86235A-008	X	X	3; MLA
86240A/8	X	X	5
86240C	X	X	3; MLA
86241A	X	X	5
86242A/C/D	X	X	5
86242D-008	X	X	3; MLA
86245A	X	X	5
86245A-008	X	X	3; MLA
86250A/C/D	X	X	5
86250D-008	X	X	3; MLA
86260A	X	X	5
86260A-H82	X	X	3; MLA
86260B/C	X	X	5
86290A/8/C	X	X	5
86290A/8-H08	X	X	4,5

MLA-Microwave Link Analyzer

#### NOTES FOR RESTRICTIONS/COMMENTS:

1. The plug-in's "CW FILTER" switch must be turned off.
2. The "FM" position of the "FM-NORM-PL" switch must be used. ("PL" may operate, depending upon sensitivity). AUTO LOCK is not supported.
3. The "NORM" position of the "MLA-NORM" switch must be used. Capture range is limited.
4. AUTO LOCK with subharmonic locking (AUX OUT) will not operate with the 8620C Option 011 and this plug-in.
5. The "PL" or "FM" position of the "FM-NORM-PL" switch must be used.
6. The 86210A, 86220A, and 8690 series will not operate with the 5344S.

3-130. Throughout this manual, the 8350A Sweep Oscillator and an 83592A (.01 to 20.0 GHz) plug-in are used for examples and discussion. Since an 8620 series Sweep Oscillator may also be used, *Table 3-9* cross references the connectors (input/output) of the sweeper mainframe. Refer to *Table 3-7* for compatibility of the 8620 series mainframes with the 5344S.

Table 3-9. 8350A/8620 Series Connector Cross Reference

8350A	8620A/B/C	Function
SWEEP OUT/IN (Front/rear panel)	SWEEP OUT (Front panel)	0 to +10V ramp concurrent with sweep. Used to detect end of sweep.
EXT TRIGGER (pin 9 of the Programming Connector)	EXT TRIGGER (Rear panel)	Initiates a sweep.
SWEEP OUT/IN (Front-rear panel)		
CNTR TRG (Rear panel)	None	Output to externally trigger 5343A Counter.
STOP SWEEP (Rear panel)	None	Input to stop progress of a forward sweep. For use with a 5343A Counter.
FM INPUT* (Rear panel)	None* (Located at rear of plug-in)	Frequency Modulation input

\*Note: The FM input for 83500 series plug-ins is located on the rear panel of the 8350A mainframe. If an 86000 series plug-in is used with the 11869A RF Plug-in Adapter in the 8350A, the 86000 series FM input is routed to the 8350A rear panel FM INPUT. The 86200 series FM INPUT is not available at the rear of the plug-in.

### 3-131. Using the 5344S With an 8640A/B Signal Generator

3-132. The 8640A/B Signal Generator cannot safely handle the -10 Volt signal that the 5344S can apply to its FM input port. The circuit shown in *Figure 3-7* installed between the 5344S FM OUT and the 8640 FM INPUT will protect the 8640 from excessive voltage and does not degrade specified performance.

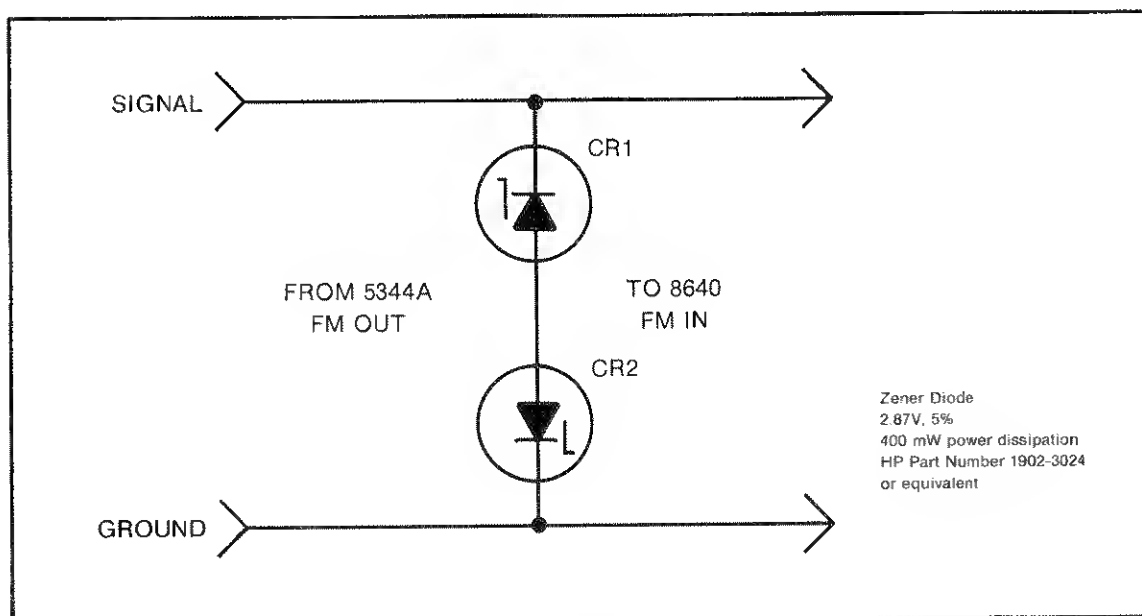


Figure 3-7. 5344A/8640A/B Interface Circuit

### 3-133. DETAILED OPERATING MODES

3-134. Figures 3-8 through 3-16 detail the four modes of operation in Manual Lock and in Auto Lock mode. These figures include all required interconnections and operating procedures. This assumes the 5344A and 5342A/43A have been connected per paragraph 2-19. These examples use the HP 8350A Sweep Oscillator and an 83592A (.01 to 20.0 GHz). Change the parameters of the examples to fit your sweeper's frequency range.

3-135. The signal level at the input of the counter should be as specified in Table 1-1, Specifications. Power splitters and directional couplers attenuate the signal level, so be sure there is sufficient signal for the counter input. When placing an attenuating device in series with the signal would cause the level to drop below the required level, a feature called Subharmonic Locking is provided. This allows the signal source's output to be used without any attenuating devices. Figure 3-17 details the Subharmonic Locking and Figure 3-18 details the Frequency Offset Locking mode.

### 3-136. Common Control Problems

3-137. Most sweep oscillators have controls and functions that, if inadvertently turned-on, may cause problems when the 5344S tries to lock. For instance, if the square-wave modulation is on, the 5344S will not be able to follow the signal and lock will not be achieved. The following Table lists some of the common controls that may create problems.

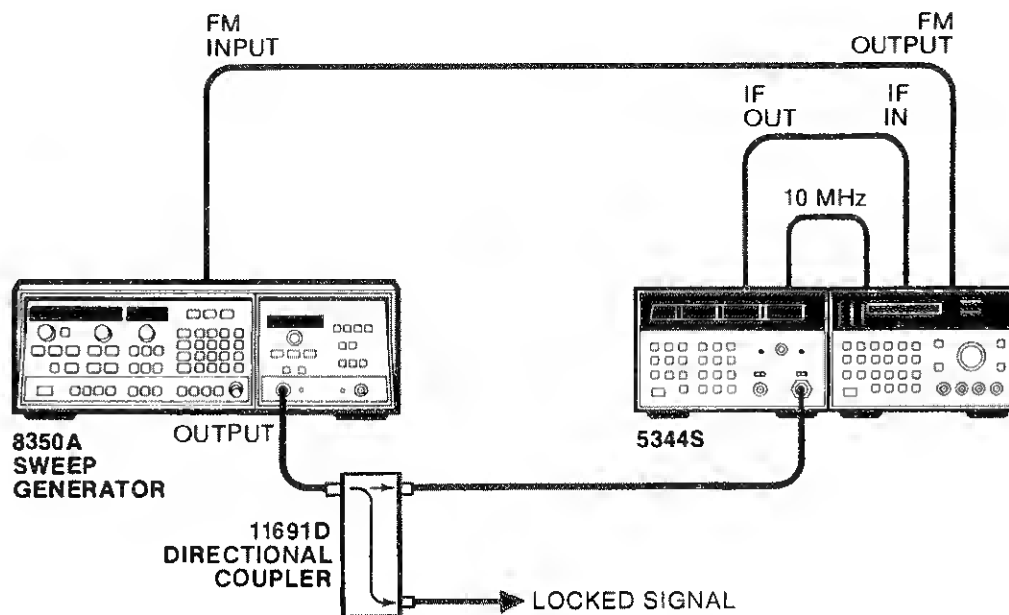
Table 3-10. Common Control Problems

- |  |
|--|
| <ol style="list-style-type: none"><li>1. Square-wave modulation turned-on or the signal being applied to the counter is being modulated in some form.</li><li>2. Sweeper's Amplitude Markers are turned-on.</li><li>3. CW filter is on.</li><li>4. RF Blanking is on during LOCK/ROLL.</li></ol> |
|--|

**Description:**

The 5344S locks the signal source to the specified CW frequency. The signal source must be manually adjusted to within 25 MHz of the desired CW frequency.

**Connections:**



**Example:**

CW locked frequency at 2.000000000 GHz.

1. Set MANUAL LOCK and AUTO LOCK off (lamp off). If AUTO LOCK is turned on, the 5344A will display error code Err 10.
2. Select CW mode on the 8350A. If the plug-in has a CW filter, turn it OFF. Verify the counter SAMPLE RATE is not in HOLD.
3. Using the 8350A DATA ENTRY keys, press:



The 8350A should display 2.000 GHz and the 5342A should display approximately 2 GHz.

4. Using the 5344A Function keys, press:
  - a. MODE until the CW annunciator lights. The MODE key will scroll through the four modes of operation. If you pass CW, continue pressing MODE until you return to CW.
5. Using the 5344A Numeric Entry keys, press:



The 5344A should display:

2.000000000 GHz

The 5344S always assumes that the remaining unentered digits are zero. Thus 1 Hz resolution always occurs.

Figure 3-8. CW in Manual

6. Press the 5344A MANUAL LOCK key.  
The LOCKED annunciator should light.
7. If the FREQ LO annunciator lights, manually raise the frequency of the 8350A until the 5342A displays  $2\text{ GHz} \pm 25\text{ MHz}$ . The 5344S will automatically tune the 8350A to the desired frequency.
8. If the FREQ HI annunciator lights, manually lower the frequency of the 8350A until the 5342A displays  $2\text{ GHz} \pm 25\text{ MHz}$ . The 5344S will automatically tune the 8350A to the desired frequency.
9. Notice that when either the FREQ HI or FREQ LO annunciators are on indicating that tuning is required, the resolution on the counter decreases to 1 KHz. This allows a very fast update of the counter display making tuning quicker and easier.

**NOTE**

The 5344S will display error code Err 01 if the frequency of the sweeper is changing too fast for the 5344S to follow. This may occur for the following reasons:

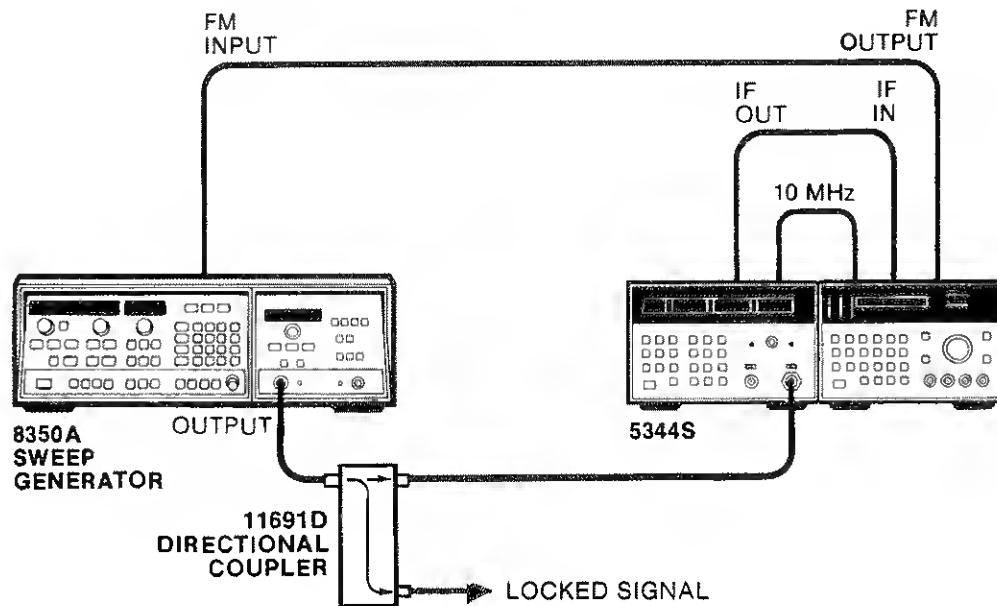
- a. The sweeper is sweeping,
- b. or when manually tuning the sweeper, it is being tuned too quickly.

*Figure 3-8. CW in Manual (Continued)*

**Description:**

The 5344S will lock the sweeper to the specified Center Frequency, and then sweep in a range around the CF as specified by the  $\Delta F$  (sweep width), by the Sweep Time specified on the 5344A.

**Connections:**



**Example:**

Center Frequency (CF) of 2 GHz and a sweep width ( $\Delta F$ ) of 20 MHz. The 5344S will sweep the source from  $CF - (\Delta F/2)$  to  $CF + (\Delta F/2)$  or 1.990 GHz to 2.010 GHz.

1. Set MANUAL LOCK and AUTO LOCK off (lamp off). If AUTO LOCK is turned on, the 5344A will display error code Err 10.
2. Select CW mode on the 8350A. If the plug-in has a CW filter, turn it OFF.
3. Using the 8350A DATA ENTRY keys, press:



the 8350A should display 2.000 GHz and the 5342A should display approximately 2 GHz.

4. Using the 5344A Function keys, press:
  - a. MODE until the CF/ $\Delta F$  annunciator lights. The MODE key will scroll through the four modes of operation. If you pass CF/ $\Delta F$ , continue pressing MODE until you return to CF/ $\Delta F$ .
5. Using the 5344A Numeric Entry keys, press:



The 5344A should display:

2.00000000 GHz

The 5344S always assumes that the remaining unentered digits are zero. Thus, 1 Hz resolution always occurs.

6. Press the F2 key on the 5344A. The LED inside the key will light to indicate that it is waiting for data to be entered and the entered value will be shown on the display.

Figure 3-9. CF/ $\Delta F$  in Manual

7. Using the 5344A Numeric Entry keys, press:



The 5344A should display:

20.000000 MHz

To see the Center Frequency value, press key F1. Unless Numeric Entry keys are pressed, the value will remain unchanged. If an invalid value is entered, the previous value will remain unchanged. If a value outside of the limits is entered, the value will default to the closest limit.

8. Press the 5344A SWP TIME key. The LED inside of the key will light to indicate that it is waiting for data to be entered.
9. Using the 5344A Numeric Entry keys, press:



10. Press the 5344A MANUAL LOCK key.  
The LOCKED annunciator should light.
11. If the FREQ LO annunciator lights, manually raise the frequency of the 8350A until the 5342A displays 2 GHz ( $\pm 15$  MHz). The 5344S will automatically tune the 8350A to the desired frequency.
12. If the FREQ HI annunciator lights, manually lower the frequency of the 8350A until the 5342A displays 2 GHz ( $\pm 15$  MHz). The 5344S will automatically tune the 8350A to the desired frequency.
13. Notice that when either the FREQ HI or FREQ LO annunciators are on, indicating that tuning is required, the resolution on the counter decreases to 1 KHz. This allows a very fast update of the counter display making tuning quicker and easier. The sweep is also halted until Lock is achieved.

#### NOTE

The 5344S will display error code Err 01 if the frequency of the sweeper is changing too fast for the 5344S to follow. This may occur for the following reasons:

- The 8350A is in SWEEP mode (vs. CW) and is sweeping, or
- When manually tuning the 8350A to within 15 MHz, it is being tuned too quickly.

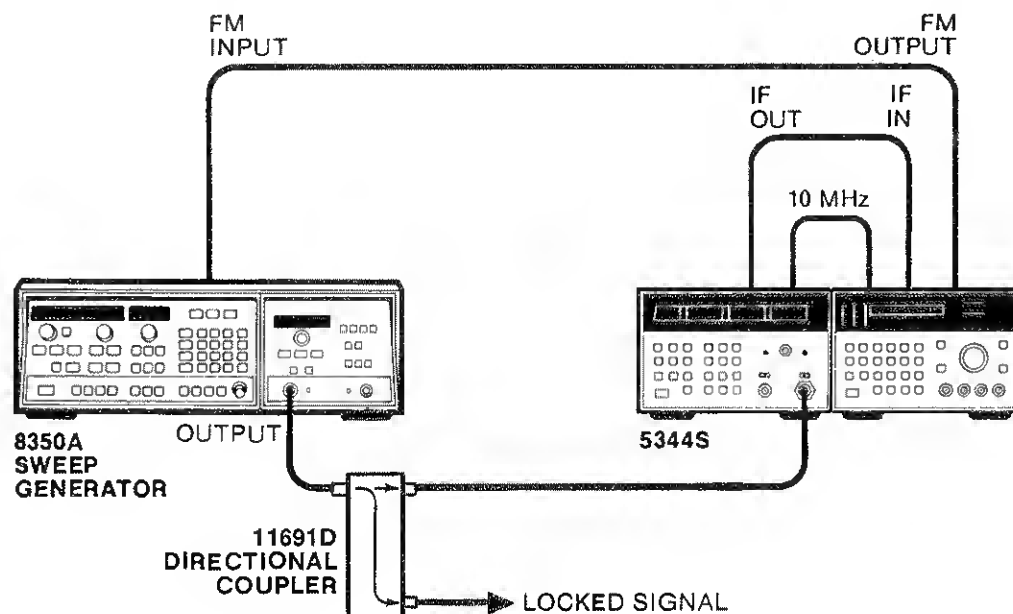
Figure 3-9. CF/ $\Delta$ F in Manual (Continued)



### Description:

The 5344S will lock the sweeper to the specified Start Frequency and then sweep from the specified Start Frequency to the specified Stop Frequency by the specified Sweep Time. The difference between the Start and Stop frequency must be less than 40 MHz. The Sweep Time range is 10 ms-100 s.

### Connections:



### Example:

Start Frequency (STRT) of 2 GHz and a Stop Frequency Stop (STOP) of 2.040 GHz.

1. Set MANUAL LOCK and AUTO LOCK off (lamp off). If AUTO LOCK is turned on the 5344A will display error code Err 10.
2. Select CW mode on the 8350A. If the plug-in has a CW filter, turn it OFF.
3. Using the 8350A DATA ENTRY keys, press:



The 8350A should display 2.020 GHz and the 5342A should display approximately 2.02 GHz.

4. Using the 5344A Function keys, press:
  - a. MODE until STRT/STOP annunciators lights. The F1 key will light indicating the 5344A is waiting for a START frequency value. The MODE key will scroll through the four modes of operation. If you pass STRT/STOP, continue pressing MODE until you return to STRT/STOP.
5. Using the 5344A Numeric Entry keys, press:



The 5344A should display:

2.00000000 GHz

The 5344S always assumes that the remaining unentered digits are zero. Thus 1 Hz resolution always occurs.

Figure 3-10. Start/Stop in Manual

6. Press the F2 key on the 5344A. The LED inside the key will light to indicate that it is waiting for a STOP frequency to be entered and the entered value will be shown on the display.
7. Using the 5344A Numeric Entry keys, press:




the 5344A should display:

2.040000000 GHz

To see the START Frequency value, press key F1. Unless Numeric Entry keys are pressed, the value will remain unchanged. If an invalid value is entered, the previous value will remain unchanged. If a value outside of the limits is entered, the value will default to the closest limit.

SWP TIME

8. Press the 5344A  key.

The LED inside the key will light to indicate that the 5344A is waiting for Sweep Time value to be entered.

9. Using the 5344A Numeric Entry keys press:



the 5344A will display:

100 ms

10. Press the 5344A MANUAL LOCK key.  
The LOCKED annunciator should light.
11. If the FREQ LO annunciator lights, manually raise the frequency of the 8350A until the 5342A displays 2.02 GHz  $\pm$  15 MHz. The 5344S will automatically tune the 8350A to the desired frequency.
12. If the FREQ HI annunciator lights, manually lower the frequency of the 8350A until the 5342A displays 2 GHz ( $\pm$  15 MHz). The 5344S will automatically tune the 8350A to the desired frequency.
13. Notice that when either the FREQ HI or FREQ LO annunciators are on indicating that tuning is required, the resolution on the counter decreases to 1 KHz. This allows a very fast update of the counter display making tuning quicker and easier. The sweep is also halted until Lock is achieved.

NOTE

The 5344S will display error code Err 01 if the frequency of the sweeper is changing too fast for the 5344S to follow. This may occur for the following reasons:

- a. The 8350A is in SWEEP mode (vs. CW) and is sweeping, or
- b. When manually tuning the 8350A to within 15 MHz it is being tuned too quickly.

Figure 3-10. Start/Stop in Manual (Continued)

**Description:**

The 5344S will lock the sweeper to the Start Frequency selected on the 5344A, and then sweep to the Stop Frequency selected on the 8350A by the Sweep Time also selected on the 8350A.

**Connections:**

There are two possible interconnections (listed below) for Lock and Roll. Use the one that is most convenient. The optional configuration is provided for applications requiring use of the programming connector that would make connection to the sweeper's EXT TRIGGER pin difficult.

**Preferred:**

Pin 9 of the 8350A Programming Connector to the 5344A rear panel SWP TRIG. Use the supplied adapter HP Part No. 8120-3545.

**Settings:**

8350A SWEEP mode in TIME.

8350A SWEEP TRIGGER in EXT.

**Optional:**

8350A rear panel STOP SWEEP to the 5344A SWP TRIG.

**Settings:**

8350A SWEEP mode to TIME.

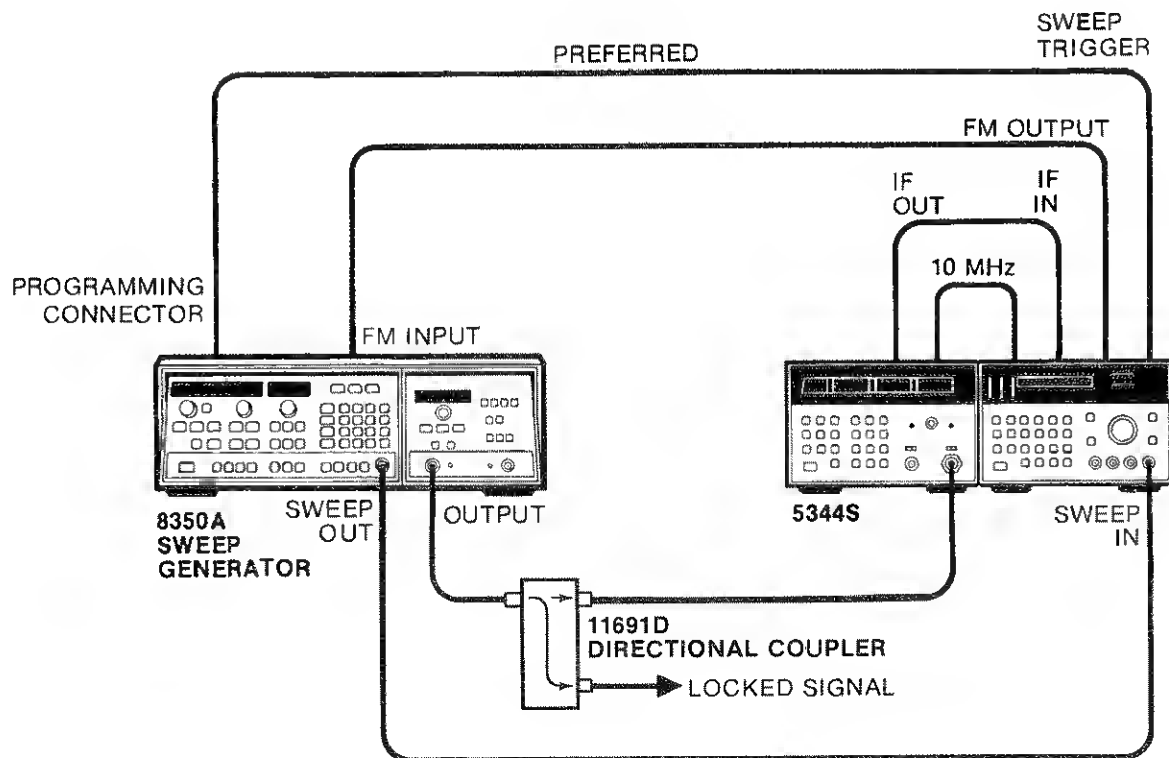


Figure 3-11. Lock and Roll in Manual

**Example:**

Start Frequency (F1) of 2 GHz and a Stop Frequency (F2) of 4 GHz with a Sweep Time of 100 ms.

1. Set MANUAL LOCK and AUTO LOCK off (lamp off.) If AUTO LOCK is turned on, the 5344A will display error code Err 10.
2. Select Start/Stop mode on the 8350A. If the plug-in has a CW filter, turn it OFF.
3. Using the 8350A DATA ENTRY keys, press:

START	and then,	2	GHz
STOP	and then,	4	GHz
SWEEP TIME	and then,	1	0 0 ms

EXT trigger; if the SWEEP TRIGGER is connected to the 8350A EXT TRIG.

INT or LINE trigger if the SWEEP TRIG is connected to the 8350A STOP SWEEP.

The 8350A should display 2.000 GHz on the START display, 4.000 GHz on the STOP display, and 0.100 SEC on the Frequency/Time display.

4. Using the 5344A Function keys, press:
  - a. MODE until the LK/R annunciator lights. The MODE key will scroll through the four modes of operation. If you pass LK/R, continue pressing MODE until you return to LK/R.
5. Using the 5344A Numeric Entry keys, press:



the 5344A should display:

2.000000000 GHz

The 5344S always assumes that the remaining unentered digits are zero. Thus, 1 Hz resolution always occurs.

6. Press the 5344A MANUAL LOCK key.  
The LOCKED annunciator should light.
7. If the FREQ LO annunciator lights, manually raise the frequency of the 8350A until the 5342A displays 2 GHz ( $\pm 25$  MHz). The 5344S will automatically tune the 8350A to the desired frequency.
8. If the FREQ HI annunciator lights, manually lower the frequency of the 8350A until the 5342A displays 2 GHz ( $\pm 25$  MHz). The 5344S will automatically tune the 8350A to the desired frequency.
9. Notice that when either the FREQ HI or FREQ LO annunciators are on indicating that tuning is required, the resolution on the counter decreases to 1 kHz. This allows a very fast update of the counter display making tuning quicker and easier. The sweep is also halted until Lock is achieved.

**NOTE**

In Lock/Roll, the signal source is locked only (briefly) at the start of each sweep. It is possible for the sweep settings to be changed during the unlocked portion of the sweep such that the starting frequency is changed by some near multiple of the current local oscillator frequency of the counter. This will result in lock being regained at the end of the current sweep, even though the frequency is nowhere near that desired. To avoid this situation, do not change any settings during a sweep. If you do get into this situation, press RESET to restart the locking algorithm.

Figure 3-11. Lock and Roll in Manual (Continued)

Due to the design of the 8350A sweeper, manually tuning it for LOCK/ROLL operation with the optional configuration is less convenient than when using the preferred method. For sweep times less than or equal to 100 ms, the 8350A waits until the end of a sweep before updating the output frequency to reflect the changes made at the front panel. Since the 5344A stops the sweep to allow tuning of the sweeper's start frequency, turning the 8350A's RPG or using its keyboard changes the sweeper's frequency display, but does not actually change the output. To change the start frequency, press EXT SWEEP TRIGGER on the 8350A front panel while tuning the LOCK/ROLL start frequency. This forces an immediate update to the output frequency. After the sweeper has been tuned and the 5344S locks, press INT or LINE SWEEP TRIGGER to start the sweep. Alternatively, the 8350A's SWEEP TIME can be set greater than 100 ms for tuning, then returned to the actual desired value after lock is achieved.

#### Counting Sweeper Markers or Stop frequency:

If the counter being used with the 5344A is a 5343A, the markers of the 8350A or Stop frequency of the sweep can be counted during Lock and Roll (only the sweeper can generate markers during Lock and Roll). The following connections are required for this feature:

#### With the preferred method:

8350A CNTR TRIG to the 5343A rear panel SWP INTFC A

8350A STOP SWEEP to the 5343A rear panel SWP INTFC B

#### With the optional method:

8350A CNTR TRIG to the 5343A SWP INTFC A

After setting up the Lock/Roll sweep, you can count the markers or Stop frequency by:

1. Pressing STOP on the 8350A. This selects which parameter is to be measured by the 5343A.
2. Pressing:

 (blue key)  on the 8350A.

This enables the counter interface function on the 8350A.

Whenever the 5344S Option 043 is locked in Lock/Roll, the sweeper interface function of the 5344S is automatically enabled. If the 5344S is not locked, simply press SWP M on the 5343A to enable the sweeper interface.

If you wish to count one of the markers on the 8350A, the operation is quite similar, except that you would select the marker you wish to count in Step 1 above, rather than the sweeper STOP frequency.

To disable the sweeper/counter interface feature, press:

 (blue key)  on the 8350A.

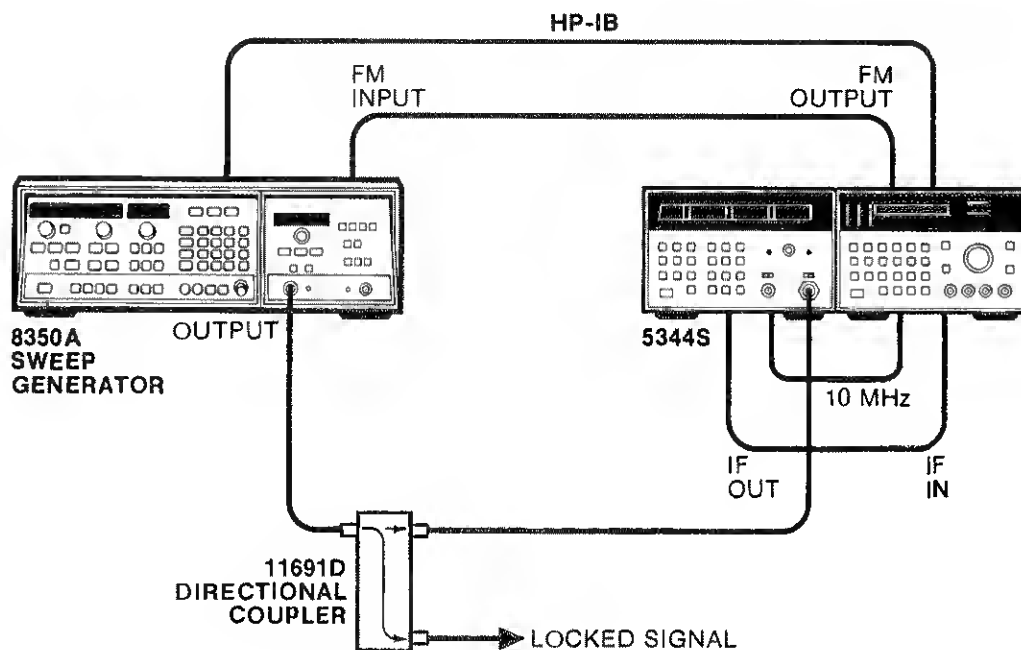
Figure 3-11. Lock and Roll in Manual (Continued)

**Description:**

The 5344S locks the signal source to the specified CW frequency. The signal source is automatically tuned by the 5344S. No manual tuning is required.

**Connections:**

1. The address of the 8350A Sweep Oscillator must be set to the same address as the 5344A. The top switch of the 5344A ADDRESS switches must be set to the SYS CONT position.



**Example:**

CW locked frequency at 2.000000000 GHz.

1. Set the 5344A HP-IB address to 00 by setting the bottom five switches to the right.
2. Set the 5344A to the System Controller mode by setting the top HP-IB switch to the left (SYS CONT.)
3. Set the 8350A address to 00 (equal to the 5344A) by pressing the following key sequence:

SHIFT (blue key) LCL 0 GHz s

The HP-IB address will be shown on the Frequency/Time display of the 8350A.

4. Set MANUAL LOCK and AUTO LOCK off (lamp off) and verify the 5344A front panel CONT lamp is on. Also verify the plug-in's CW Filter is off.
5. Using the 5344A Function keys, press and release MODE until the CW annunciator lights. The MODE key will scroll through the four modes of operation. If you pass CW, continue pressing MODE until you return to CW.

Figure 3-12. CW in AUTO LOCK

6. Using the 5344A Numeric Entry keys press:



The 5344A should display:

2.000000000 GHz

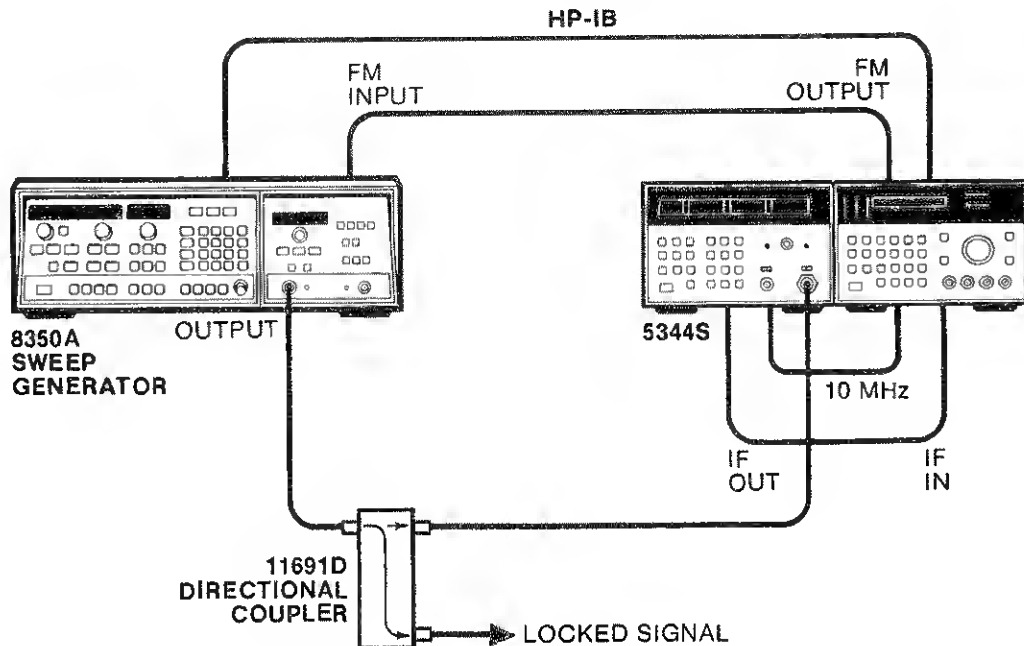
7. Press the 5344A AUTO LOCK key. The 5344A will now program the 8350A to the specified CW frequency. If the 8350A actual output frequency is not within the lock range of the 5344A, the 5344S will begin stepping the frequency in an attempt to bring it within range. If it is unsuccessful, Err 11 will be displayed. This is a possible indication that the 8350A and/or its plug-in is out of electrical alignment.

Figure 3-12. CW in AUTO LOCK (Continued)

**Description:**

The 5344S will lock the sweeper to the specified Center Frequency, and then sweep in a range around the CF as specified by the  $\Delta F$  (sweep width) by the Sweep Time specified on the 5344A.

**Connections:**



**Example:**

Center Frequency (CF) of 2 GHz and a sweep width ( $\Delta F$ ) of 20 MHz. The 5344S will sweep the sweeper from  $CF - (\Delta F/2)$  to  $CF + (\Delta F/2)$  or 1.990 GHz to 2.010 GHz.

1. Set the 5344A HP-IB address to 00 by setting the bottom five switches to the right.
2. Set the 5344A to the System Controller mode by setting the top HP-IB switch to the left (SYS CONT.)
3. Set the 8350A address to 00 (equal to the 5344A) by pressing the following key sequence:



The HP-IB address will be shown on the Frequency/Time display of the 8350A.

4. Set MANUAL LOCK and AUTO LOCK off (lamp off) and verify the 5344A front panel CONT lamp is on. Also verify the plug-in's CW Filter is off.
5. Using the 5344A Function keys, press and release MODE until the CF/ $\Delta F$  annunciator lights. The MODE key will scroll through the four modes of operation. If you pass CF/ $\Delta F$ , continue pressing MODE until you return to CF/ $\Delta F$ . The LED inside the F1 key will light.
6. Using the 5344A Numeric Entry keys press:



The 5344A should display: 2.000000000 GHz

Figure 3-13. CF/ $\Delta F$  in AUTO LOCK



7. Press the F2 key on the 5344A. The LED inside the key will light to indicate that it is waiting for data to be entered and the entered value will be shown on the display.
8. Using the 5344A Numeric Entry keys press:



The 5344A should display:

20.000000 MHz

If you want to see the Center Frequency value, press key F1. Unless Numeric Entry keys are pressed, the value will remain unchanged. If an invalid value is entered, the previous value will remain unchanged. If a value outside of the limits is entered, the value will default to the closest limit.

9. Press the 5344A SWP TIME key. The LED inside the key will light to indicate that the 5344A is waiting for a Sweep Time value to be entered.
10. Using the 5344A Numeric Entry keys, press:



the 5344A will display:

100 ms

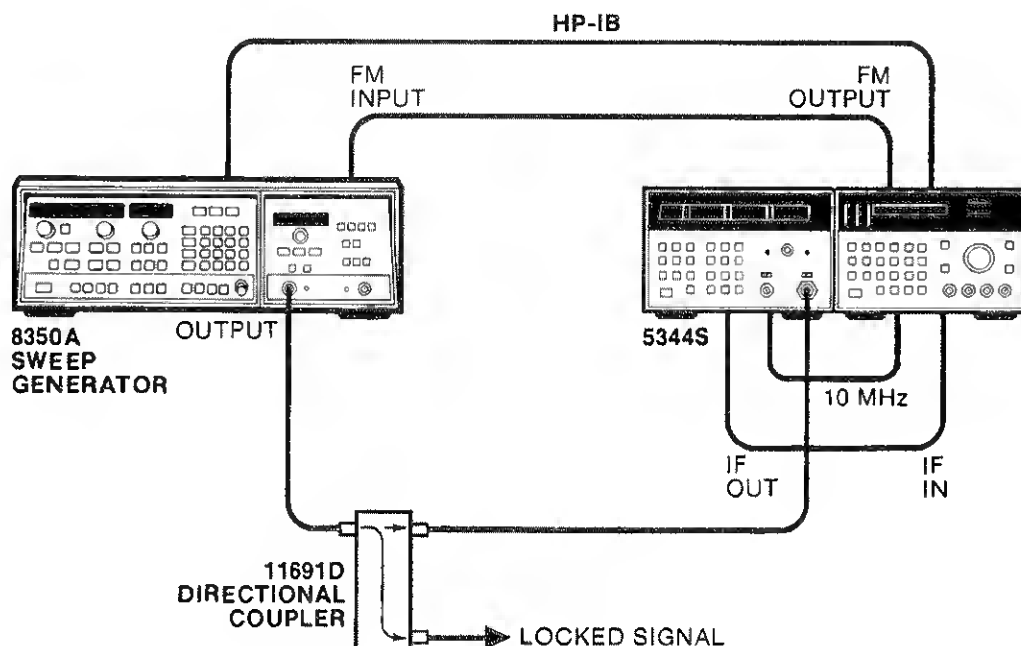
11. Press the 5344A AUTO LOCK key. The 5344A will now program the 8350A to the specified CF frequency, and then sweep over the specified  $\Delta F$  range. The LOCKED annunciator should light. If the 8350A actual output frequency is not within the lock range of the 5344A, the 5344S will begin stepping the frequency in an attempt to bring it within range. If it is unsuccessful, Err 11 will be displayed. This is a possible indication that the 8350A and/or its plug-in is out of electrical alignment.

Figure 3-13. CF/ $\Delta F$  in AUTO LOCK (Continued)

### Description:

The 5344S will lock the sweeper to the specified Start Frequency, and then sweep from the specified Start Frequency to the specified Stop Frequency using the specified Sweep Time. The difference between the Start and Stop frequency must be less than or equal to 40 MHz. The Sweep time range is 10 ms-100 s.

### Connections:



### Example:

Start Frequency (STRT) of 2 GHz and a Stop Frequency Stop (STOP) of 2.040 GHz with a Sweep Time of 100 mS.

1. Set the 5344A HP-IB address to 00 by setting the bottom five switches to the right.
2. Set the 5344A to the System Controller mode by setting the top HP-IB switch to the left (SYS CONT.)
3. Set the 8350A address to 00 (equal to the 5344A) by pressing the following key sequence:

SHIFT (blue key) LCL 0 GHz<sub>s</sub>

4. Set MANUAL LOCK and AUTO LOCK off (lamp off) and verify the 5344A front panel CONT lamp is on. Also verify the plug-in's CW Filter is off.
5. Using the 5344A Function keys, press and release MODE until the START/STOP annunciator lights. The F1 key will light indicating the 5344A is waiting for a START frequency value. The MODE key will scroll through the four modes of operation. If you pass STRT/STOP, continue pressing MODE until you return to STRT/STOP. The F1 key will light.

Figure 3-14. Start/Stop in AUTO LOCK

6. Using the 5344A Numeric Entry keys press:



The 5344A should display:

2.00000000 GHz

7. Press the F2 key on the 5344A. The LED inside the key will light to indicate that it is waiting for a STOP frequency to be entered and the entered value will be shown on the display.
8. Using the 5344A Numeric Entry keys press:



The 5344A should display:

2.04000000 GHz

If you want to see the START Frequency value, press key F1. Unless Numeric Entry keys are pressed, the value will remain unchanged. If an invalid value is entered, the previous value will remain unchanged.

9. Press the 5344A SWP TIME key. The LED inside the key will light to indicate that the 5344A is waiting for a Sweep Time value to be entered.
10. Using the 5344A Numeric Entry keys press:



The 5344A will display:

100 ms

11. Press the 5344A AUTO LOCK key. The 5344A will now program the 8350A to the center of the specified Start/Stop frequency range, and then sweep from Start to Stop. The LOCKED annunciator should light. If the 8350A actual output frequency is not within the lock range of the 5344A, the 5344A will begin stepping the frequency in an attempt to bring it within range. If it is unsuccessful, Err 11 will be displayed. This is a possible indication that the 8350A and/or its plug-in is out of electrical alignment.

Figure 3-14. Start/Stop in AUTO LOCK (Continued)

**NOTE**

Lock and Roll in Auto Lock will not operate with an 8620 series sweep oscillator.

**Description:**

The 5344S will lock the sweeper to the Start Frequency selected on the 5344A and then sweep to the Stop Frequency selected on the 8350A by the Sweep Time also selected on the 8350A.

**Connections:**

There are two possible interconnections for Lock and Roll. Use the one that is most convenient. The optional configuration is provided for applications requiring use of the programming connector that would make connection to the sweeper's EXT TRIGGER pin difficult.

**Preferred:**

Pin 9 of the 8350A Programming Connector to the 5344A rear panel SWP TRIG. Use the supplied adapter HP Part No. 8120-3545.

**Settings:**

8350A Sweep mode in TIME.  
8350A Sweep Trigger in EXT.

**Optional:**

8350A rear panel STOP SWEEP to the 5344A SWP TRIG.

**Settings:**

8350A Sweep mode to TIME.  
8350A Sweep Trigger to INT or LINE.

**Connections:**

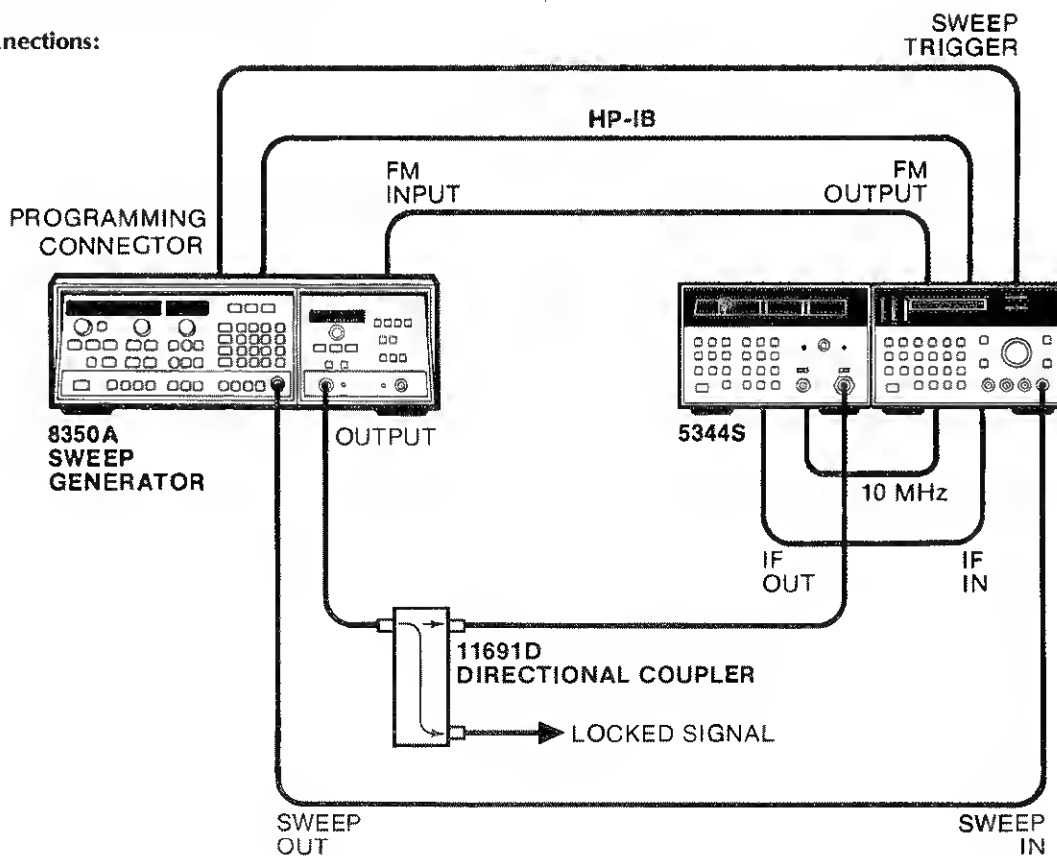


Figure 3-15. Lock and Roll in AUTO LOCK

**Example:**

Start Frequency of 2 GHz and a Stop Frequency of 5 GHz with a Sweep Time of 100 mS.

1. Set the 5344A HP-I8 address to 00 by setting the bottom five switches to the right.
2. Set the 5344A to the System Controller mode by setting the top HP-I8 switch to the left (SYS CONT.).
3. Set the 8350A address to 00 (equal to the 5344A) by pressing the following key sequence:



4. Set MANUAL LOCK and AUTO LOCK off (lamp off) and verify the 5344A front panel CONT lamp is on. Also verify the plug-in's CW Filter is off.
5. Using the 5344A Function keys, press and release MODE until the LK/R annunciator lights. The MODE key will scroll through the modes of operation. If you pass LK/R, continue pressing MODE until you return to LK/R.
6. Using the 5344A Numeric Entry keys, press:



The 5344A should display:

2.00000000 GHz

7. Now enter the Stop frequency on the 8350A. Using the 8350A keys, press the following keys in sequence:



The 8350A STOP display should be:

5.00 GHz

8. Now enter the Sweep Time. Using the 8350A keys, press the following in sequence:



The 8350A TIME display should be:

0.100 SEC

9. Press the 5344A AUTO LOCK key. The 5344A will now program the 8350A to the specified Start Frequency, and then sweep from Start to Stop. The LOCKED annunciator should light. If the 8350A actual output frequency is not within the lock range of the 5344A, the 5344A will begin stepping the frequency in an attempt to bring it within range. If it is unsuccessful, Err 11 will be displayed. This is a possible indication that the 8350A and/or its plug-in is out of electrical alignment.

**Counting Markers or Stop frequency:**

If the counter being used with the 5344A is a 5343A, the markers or Stop frequency of the sweep can be counted during Lock and Roll. The following connections are required for this feature:

**With the preferred method:**

- 8350A CNTR TRIG to the 5343A rear panel SWP INTFC A
- 8350A STOP SWEEP to the 5343A rear panel SWP INTFC 8



Figure 3-15. Lock and Roll in AUTO LOCK (Continued)

**With the optional method:**

8350A CNTR TRIG to the 5343A SWP INTFC A

After setting up the Lock/Roll sweep, you can count the markers or Stop frequency by:

1. Pressing STOP on the 8350A. This selects which parameter is to be measured by the 5343A.
2. Pressing:



 (blue key)  on the 8350A.

This enables the counter interface function on the 8350A.

Whenever the 5344S Option 043 is locked in Lock/Roll, the sweeper interface function of the 5344S is automatically enabled. If the 5344S is not locked, simply press SWP M on the 5343A to enable the sweeper interface.

If you wish to count one of the markers on the 8350A, the operation is quite similar except that you would select the marker you wish to count in Step 1 above, rather than the sweeper STOP frequency.

To disable the sweeper/counter interface feature, press:

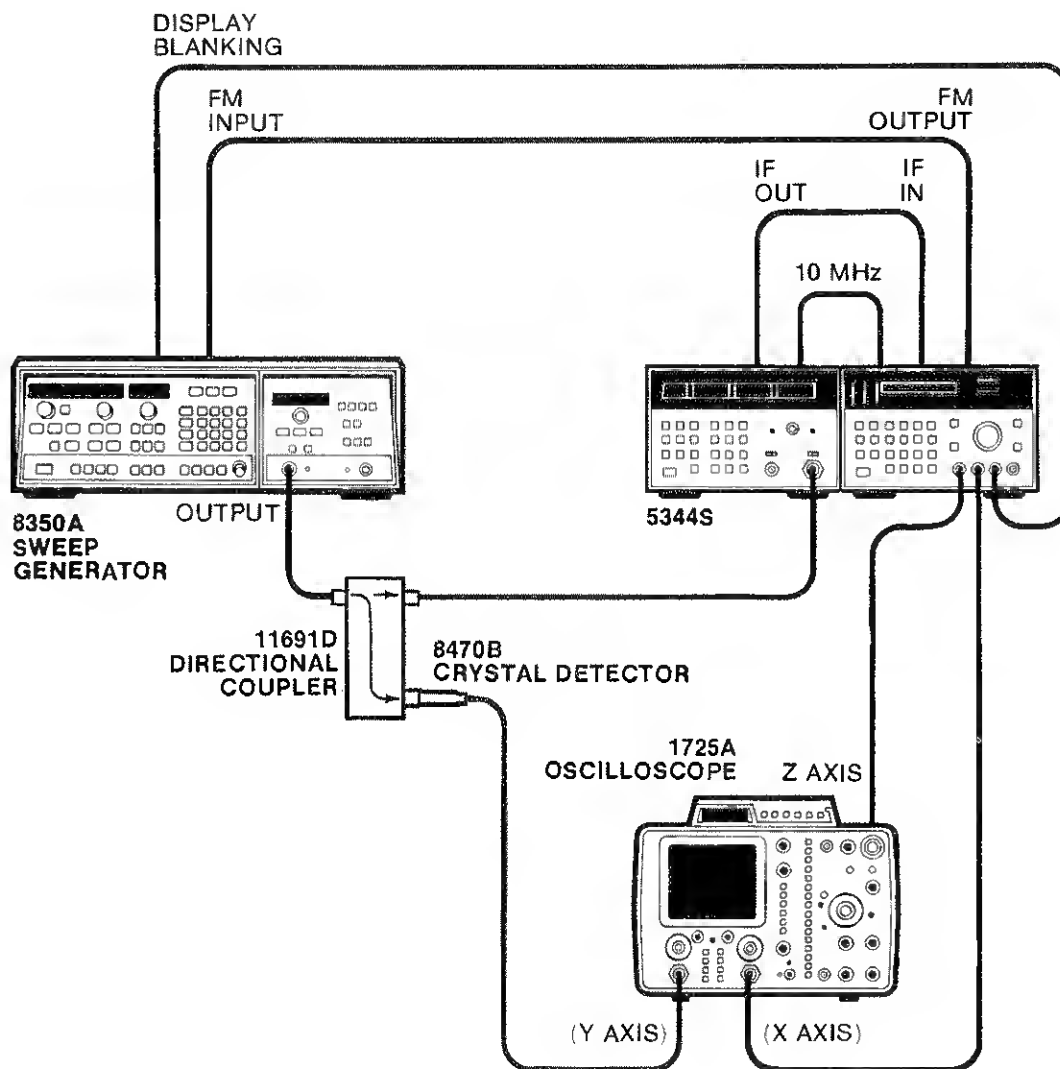
 (blue key)  on the 8350A.

*Figure 3-15. Lock and Roll in AUTO LOCK (Continued)*

**Description:**

The 5344S can generate 4 markers in CF/ $\Delta$ F and Start/Stop mode.

**Connections:**



**Example:**

The 5344S will sweep from 2 GHz to 2.040 GHz generating one marker at the center of the sweep.

1. Set MANUAL LOCK and AUTO LOCK off (lamp off). If AUTO LOCK is turned on the 5344A will display error code Err 10.
2. Select CW mode on the 8350A. If the plug-in has a CW filter, turn it OFF.
3. Using the 8350A DATA ENTRY keys press:



The 8350A should display 2.020 GHz and the 5342A should display 2.02 GHz  $\pm$  10 MHz.

Figure 3-16. Markers

4. Using the 5344A Function keys, press and release MODE until the START/STOP annunciator lights. The F1 key will light indicating the 5344A is waiting for a START frequency value. The MODE key will scroll through the four modes of operation. If you pass STRT/STOP, continue pressing MODE until you return to STRT/STOP.

5. Using the 5344A Numeric Entry keys, press:

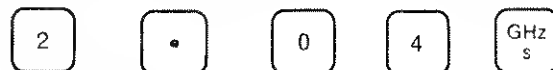


The 5344A should display:

2.000000000 GHz

6. Press the F2 key on the 5344A. The LED inside the key will light to indicate that it is waiting for a STOP frequency to be entered and the entered value will be shown on the display.

7. Using the 5344A Numeric Entry keys, press:



The 5344A should display:

2.040000000 GHz

If you want to see the START Frequency value, press key F1. Unless Numeric Entry keys are pressed the value will remain unchanged. If an invalid value is entered the previous value will remain unchanged.

8. Press the 5344A SWP TIME key.

The LED inside the key will light to indicate that the 5344A is waiting for Sweep Time value to be entered.

9. Using the 5344A Numeric Entry keys press:



The 5344A will display:

500 ms

10. Press the 5344A MANUAL LOCK key.

The LOCKED annunciator should light.

11. Set the oscilloscope for an X-Y display. Adjust the Horizontal gain for a full width trace and center the trace with the vertical gain.

12. Press the 5344A MKR FREQ key. The lamp inside of the key will flash indicating the 5344A is waiting for one of the marker registers (1 through 4) to be selected.

13. Using the 5344A Data Entry keys, select Marker one by pressing key 1.

14. Unless a marker has been previously entered, the 5344A should display:

0.000000 MHz

This indicates Marker 1 is OFF.

15. Using the 5344A Numeric Entry keys press:



The marker should now be seen on the oscilloscope screen as an intensified dot.

16. Now rotate the RPG knob clockwise and note the dot moves toward the right side of the sweep trace. The Marker 1 frequency is being increased toward the Stop frequency. When the marker frequency equals the Stop frequency, or it violates minimum marker spacing restrictions described in paragraph 3-47, Err 02 is displayed and the marker is ignored.

Figure 3-16. Markers (Continued)



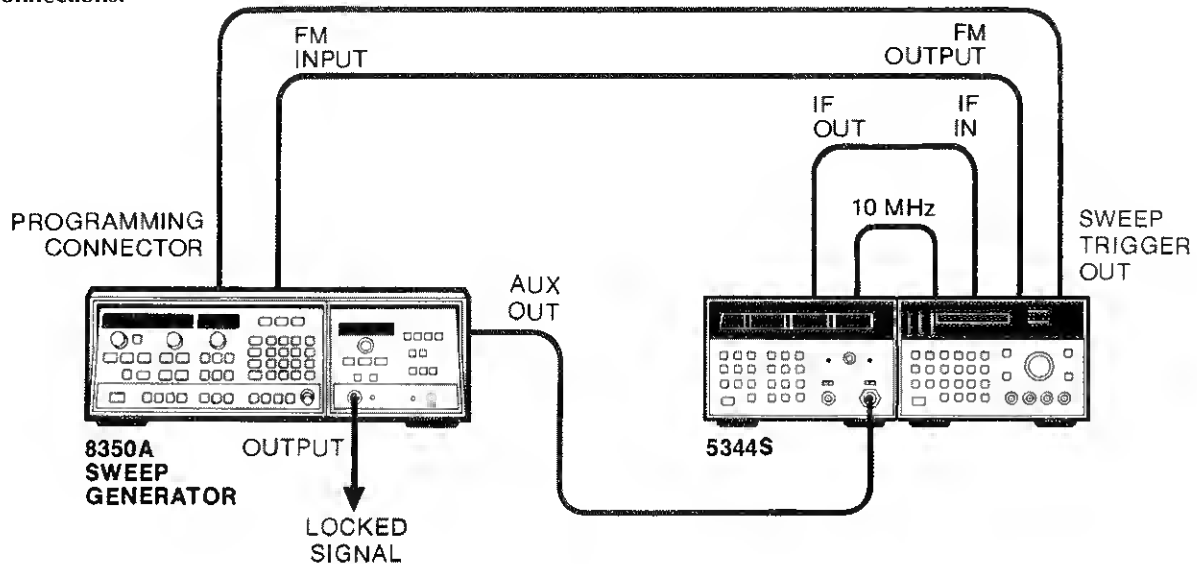
17. Now rotate the RPG knob counter-clockwise. The marker will reappear on the trace. Move the marker towards the Start frequency. Again when the marker is too close to the Start frequency, or it violates the minimum separation restrictions described in paragraph 3-46, the marker will disappear. However, when the marker is too close to the Start frequency, no error is displayed.
18. Move marker 1 up to 2.01 GHz.
19. As described in steps 13 and 15, select Marker 2 and place it at 2.030 GHz.  
You should now see two dots on the sweep trace.
20. Again using the RPG knob, move Marker 2 down towards Marker 1. Notice that when Marker 2 becomes too close to Marker 1, Marker 2 disappears. Whenever any two markers conflict, the higher frequency conflicting marker is ignored. The marker will always return once the spacing conflict is resolved.
21. Select Marker 3 and place it at 2.02 GHz.
22. Two more markers could be selected provided there is no conflict.

*Figure 3-16. Markers (Continued)*

### Description:

This procedure will demonstrate Subharmonic Locking. The actual front panel output frequency will be 15 GHz. To avoid placing any attenuating devices in series with the output, the rear panel AUX OUT (YTO) will be used for the locking signal. The Frequency Multiplier will be set to 1 for automatic determination.

### Connections:



### Example:

The 5344S will be placed into CW mode. 15 GHz will be selected on the 5344A.

1. Set MANUAL LOCK and AUTO LOCK off (lamp off). If AUTO LOCK is turned on, the 5344A will display error code Err 10.
2. Set the 5344A rear panel Mode switch to the SUB HMNC position.
3. Set the 5344A Frequency Multiplier to 1. On the 5344A press:



4. Select CW mode on the 8350A. If the plug-in has a CW filter, turn it OFF.
5. Using the 8350A DATA ENTRY keys, press:



The 8350A should display 15.000 GHz.

6. Notice that the counter is not displaying 15 GHz, but the frequency the YTO is at before any multiplication. If you knew the multiplier value, the counter display would be of some use, but let's assume the value is unknown.
7. Using the 5344A Function keys, press and release MODE until the CW annunciator lights. The F1 key will light indicating the 5344A is waiting for a CW frequency value.
8. Using the 5344A Numeric Entry keys press:



The 5344A should display:

15.00000000 GHz

Figure 3-17. Subharmonic Locking Mode

9. Press the MANUAL LOCK key.  
The LOCKED annunciator should light.
10. The 5344A will now divide the entered value of 15 GHz by the YTO frequency being displayed on the counter. The resulting value will be rounded to the nearest integer. The 5344A will determine the YTO frequency required to achieve lock. From this, the 5344A will turn on the FREQ HI or FREQ LO annunciator indicating the direction the YTO frequency must be tuned.
11. If the FREQ LO annunciator lights, manually raise the frequency of the 8350A until the 5344A locks.
12. If the FREQ HI annunciator lights, manually lower the frequency of the 8350A until the 5344A locks.
13. Notice that the counter is now displaying the actual output frequency of the plug-in even though it's counting the rear panel AUX OUT. The counter display is multiplied by the Frequency Multiplier value so the true output and the counter's display are the same. When the 5344S is not locked, or either MANUAL or AUTO LOCK are off, the counter will always display the true frequency it's counting. When Lock is achieved, the counter display will be multiplied so it displays the actual front panel output frequency.

#### NOTE

The 5344S has no way of determining the amount by which the YTO is being multiplied before being sent to the front panel of the plug-in. The 5344S is dependent upon the CW value entered on the 5344A. For example, if the YTO range is 2 to 5 GHz you could enter 20 GHz on the 5344A front panel and then press MANUAL LOCK. If the YTO was tuned close enough to a subharmonic of 20 GHz, lock could be achieved. The counter will display 20 GHz and nothing would appear wrong. But what if the 8350A was set to 10 GHz? The YTO would be at 5 GHz, the 5344S would determine the Frequency Multiplier to be  $4 \times 5 \text{ GHz} = 20 \text{ GHz}$ . The YTO would still be at 5 GHz. The 5344A and the counter would display 20 GHz, but the 8350A is really generating 10 GHz. The 5344S cannot detect that the 8350A is really at 10 GHz. The easiest way to avoid this situation is to set the 8350A as close as possible to the true desired output frequency. This way the YTO will require only a minor amount of tuning to achieve lock and the possibility of the 5344A determining the wrong multiplier is reduced. AUTO LOCK would also avoid this since the 5344A programs the 8350A to the desired frequency. A good practice is to compare the 5344A/counter and 8350A display when using MANUAL LOCK. The displays should be the same.

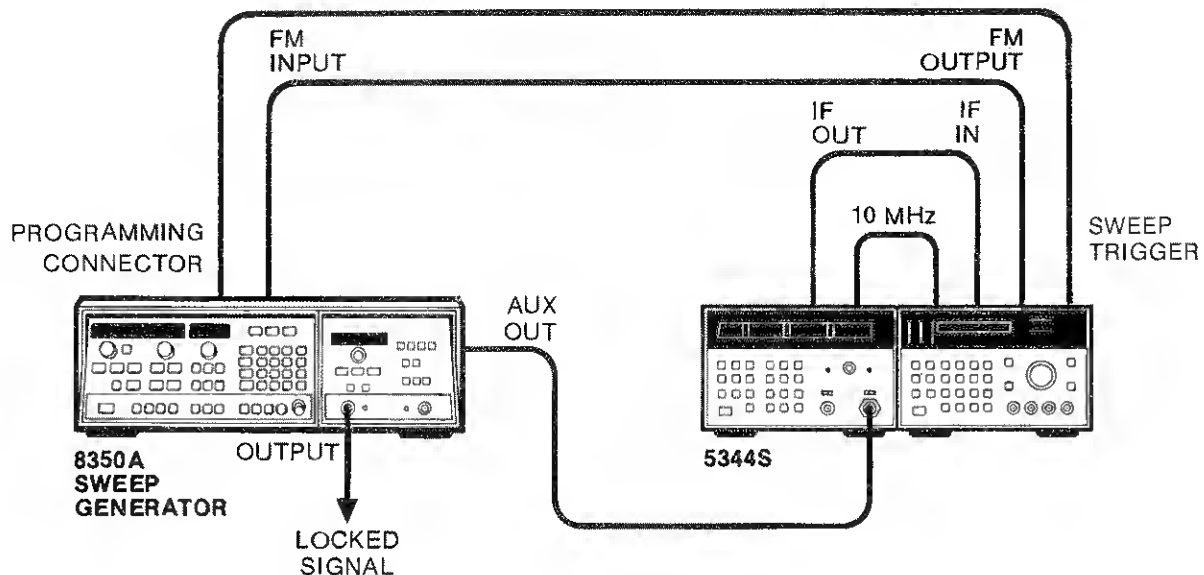
14. If AUTO LOCK had been used, the 5344A would have automatically programmed, the 8350A to 15 GHz.

Figure 3-17. Subharmonic Locking Mode (Continued)

**Description:**

This procedure will demonstrate Frequency Offset Locking. The actual front panel output frequency will be 10 MHz. The rear panel AUX OUT (YTO) will be used for the locking signal.

**Connections:**



**Example:**

The 5344S will operate in CW mode and 10 MHz will be the locked frequency.

**NOTE**

Since there is no control over the Cavity Oscillator in the plug-in, the output signal is not phase locked.

1. First determine the frequency of the Cavity Oscillator in the plug-in. For the 83592A it is 3.8 GHz.
2. Now enter the Cavity Oscillator frequency into the counter as an offset. Since the 5342A and 5343A adds all offsets, the value must be entered as negative.

On the counter front panel press:



Now 3.8 GHz will be subtracted from all frequencies applied to the counter.

3. Set the 5344A rear panel Mode switch to the SUB HMNC position.
4. Select CW mode on the 8350A. If the plug-in has a CW filter, turn it OFF.
5. Using the 8350A DATA ENTRY keys press:



The 8350A should display 10.00 MHz.

6. Notice that the counter is not displaying 10 MHz, but the frequency of the YTO before being mixed with the Cavity Oscillator.
7. Using the 5344A Function keys, press and release MODE until the CW annunciators lights. The F1 key will light indicating the 5344A is waiting for a CW frequency value.

Figure 3-18. Frequency Offset Locking

8. Using the 5344A Numeric Entry keys press:



The 5344A should display:

10.000000 MHz

9. Press the MANUAL LOCK key.

The LOCKED annunciator should light.

10. If the FREQ LO annunciator lights, manually raise the frequency of the 8350A until the 5344A locks.
11. If the FREQ HI annunciator lights, manually lower the frequency of the 8350A until the 5344A locks.
12. Notice that the counter is now displaying the actual output frequency of the plug-in although it's counting the rear panel AUX OUT. The counter display is offset by the Cavity Oscillator value so the true output and the counter's display are the same. When the 5344S is not locked, or either MANUAL LOCK or AUTO LOCK are off, the counter will always display the true frequency it is counting. When Lock is achieved, the counter display will be offset so it displays the actual front panel output frequency.
13. Above 2.4 GHz, the 83592A plug-in does not use the Cavity Oscillator, so frequency Offset Locking is limited to the range where the output of the plug-in is generated by mixing it with a fixed frequency oscillator.
14. If AUTO LOCK was being used, the 8350A would have been automatically programmed to 10 MHz.

#### NOTE

When performing Frequency Offset Locking procedures, if you know the true frequency of the Cavity Oscillator in the plug-in, enter that value. In this procedure, you entered 3.8 GHz as the offset. If the Cavity Oscillator is really at 3.7995xxxx GHz and this value is entered, the true output of the plug-in when Locked will be closer to the selected value. To determine the true frequency of the Cavity Oscillator, apply the locked signal to the input of another counter. If the sweeper is locked at 10 MHz the second counter probably isn't displaying exactly 10 MHz. This error is the amount the Cavity Oscillator is off from the value entered into the 5344S system's counter. As an offset into the second counter, enter the frequency to which the sweeper is locked. In this example, you would enter an offset of -10 MHz. Now the second counter is displaying the amount the Cavity Oscillator is off frequency. If the result is positive, lower the offset frequency by that amount. If the result is negative, increase the offset by that amount.

On the second counter, note the least significant digit that is stable. For example, the 1 KHz position is stable, but the 100 Hz position and below are not. When entering the true offset in the 5344S system's counter, limit the offset to the LSD that is stable.

Figure 3-18. Frequency Offset Locking (Continued)



### 3-138. REMOTE PROGRAMMING VIA THE HP-IB INTERFACE

#### 3-139. Introduction

3-140. The 5344S Source Synchronizer is compatible with the Hewlett-Packard Interface Bus (HP-IB). Remote programming is installed as standard equipment and allows the 5344S to respond to remote control instructions as described in the following paragraphs. The 5344S also has the capability to act as a system controller for use with HP-IB compatible sweep oscillators, such as the 8350A Sweep Oscillator.

#### NOTE

HP-IB is Hewlett-Packard's implementation of IEEE Std. 488-1978, "Standard Digital Interface for Programmable Instrumentation".

3-141. The user must be familiar with the selected controller (9B25A, 9826A, 9835A, 9B45A, or 85A computers), the HP-IB, and the manual operation and functional capabilities of the 5344S.

### 3-142. HP-IB MODES OF OPERATION

3-143. There are two major modes of 5344S HP-IB operation:

1. Programmable — Where the 5344S is connected to a controller (and possibly other devices) via HP-IB and can be programmed remotely.
2. System Controller — Where the 5344S is connected only to a HP 8350A Sweep Oscillator via HP-IB and acts as a controller (this is called AUTO LOCK).

#### NOTE

The 5342A or 5343A counter used with the 5344A may also have HP-IB capability (Option 011 installed). In general, the counter's HP-IB interface is independent of the 5344A's, and may be accessed normally to control the counter. The only difference occurs when the 5344A is in Lock mode (MANUAL LOCK or AUTO LOCK button lit), then the counter's HP-IB interface is inactive. Attempting to send codes to, or read from the counter will cause all bus activity to stop.

3-144. When the 5344S is in the Programmable mode, the counter and 5344A would normally be on the same HP-IB bus, controlled by the same remote controller. In System Controller mode (Auto Lock), the 5344A is connected to the sweeper via the HP-IB, and the counter may be connected to a remote controller on a separate bus.

### 3-145. PROGRAMMABLE MODE

#### 3-146. Interface Functions Subset

3-147. The capability of a device connected to the bus is specified by its interface function subset. These functions provide the means for a device to receive, process, and send messages over the bus. Table 3-17 lists the 5344S interface functions using the terminology of the IEEE 488-1978 standard. These functions are also listed on the rear panel (adjacent to the HP-IB connector) as follows:

SH1, AH1, T2, L2, SR1, RL1, PP0, DC1, DT1, C0, E1



Table 3-11. HP-IB Interface Functions

Interface Function Subset Identifier	Interface Function Description
SH1	Complete Source Handshake Capability
AH1	Complete Acceptor Handshake Capability
T2	Talker (Basic Talker, Serial Poll, No Talk Only, Doesn't Unaddress If MLA)
L2	Listener (Basic Listener, No Listen Only, Doesn't Unaddress If MLA)
SR1	Complete Service Request Capability
RL1	Complete Remote/Local Capability
PP0	No Parallel Poll Capability
DC1	Complete Device Clear Capability
DT1	Complete Device Trigger Capability
C0	No System Controller Capability
E1	Open Collector Drivers

### 3-148. Bus Messages

3-149. Through bus messages, devices on the bus can exchange control and measurement information. There are 12 basic messages which can be sent over the interface. Table 3-12 lists each bus message, giving a condensed description of the 5344S's response, and examples of various controller's implementation of these messages. Paragraph 3-150 provides a more detailed description of these messages.

Table 3-12. HP-IB Messages

HP-IB MESSAGE	DESCRIPTION/RESPONSE	SAMPLE HP 85A Address=20	IEEE 488 USAGE
DATA	Method for sending commands to the 5344A and receiving measurement data.	OUTPUT 720; "CW2GZLK1" ENTER 720;A	
TRIGGER	Used in LOCK/ROLL mode to initiate a sweep. Used in CF/ΔF and START/STOP to initiate a locked sweep.	TRIGGER 7 TRIGGER 720	GET LAG, GET
CLEAR	Aborts any partially entered HP-IB data message.	CLEAR 7 CLEAR 720	DCL LAG, SDC
REMOTE	5344S goes remote. All front panel controls are disabled (except RESET). All functions and modes remain the same as local unless changed by a DATA message.	REMOTE 7 REMOTE 720	REN REN, LAG
LOCAL	Returns 5344A to front panel control.	LOCAL 720	LAG, GTL
LOCAL LOCKOUT	Disables front panel reset key; only controller can return 5344A to local operation.	LOCAL LOCKOUT 7	LLO
GO TO LOCAL AND CLEAR LOCAL LOCKOUT	5344A returns to local operation. Local Lockout is cleared.	LOCAL 7	REN



Table 3-12. HP-IB Messages (Continued)

HP-IB MESSAGE	DESCRIPTION/RESPONSE	SAMPLE HP 85A Address=20	IEEE 488 USAGE
SERVICE REQUEST	5344A will request service when OUT OF LOCK condition exists, or when END OF SWEEP has been detected.	A=STATUS 7 IF BIT (A, 3)=1 Then SRQ is set	
STATUS BYTE	Presents status information.	STATUS 720	LAG, SPE, TAG, (accept status byte), LAG, SPD
PASSS CONTROL	Not applicable.		
ABORT	Terminates all HP-IB activity and returns control to the system controller.	ABORTIO 7	IFC

### 3-150. 5344S Bus Message Response

- a. **REMOTE:** The 5344A goes Remote when it receives the REMOTE message on the HP-IB. All front panel controls except the RESET key are ignored. In REMOTE operation, the 5344S is programmed by the controller via messages sent over the bus. Until changed, the state of the 5344S remains as it was prior to receipt of the REMOTE message. Any partially entered keyboard sequence is aborted.
- b. **LOCAL:** Returns the 5344S to front panel control. (HP-IB bus activity is ignored until another REMOTE message is sent). Otherwise, the state of the 5344S remains as it was prior to receipt of the LOCAL message, except for LOOP BANDWIDTH which defaults to Wide, and Subharmonic mode which defaults to NORM.  
Any partially entered HP-IB data message is aborted.

#### NOTE

The 5344A does not respond to any messages other than REMOTE and serial polls (see STATUS BYTE) when in LOCAL operation.

- c. **LOCAL LOCKOUT:** Disables the 5344A RESET key. The 5344A remains in remote operation until a LOCAL or CLEAR LOCKOUT & LOCAL message is received on the bus. The LOCAL LOCKOUT message can be used to maintain "absolute" programmatic control of the 5344S.
- d. **GO TO LOCAL AND CLEAR LOCAL LOCKOUT:** Returns the 5344S to front panel control following a LOCAL LOCKOUT message. Otherwise, the state of the 5344S remains as it was prior to receipt of the CLEAR LOCKOUT & message. Any partially entered HP-IB data message is aborted.
- e. **ABORT:** Terminates any HP-IB activity and returns control to the system controller. The 5344A HP-IB interface is reset to the state entered when remote operation is first enabled. 5344S parameters and lock state remain as they were before the ABORT message. Any partially entered HP-IB data message is aborted.





- f. **CLEAR:** Aborts any partially entered HP-IB data message.
- g. **TRIGGER:** Used in LOCK/ROLL mode to release lock and initiate a sweep, and in CF/ $\Delta$ F and START/STOP modes to initiate a locked sweep. It is ignored in CW mode. (The HP-IB controller should check the STATUS byte to ensure that lock has been achieved and end-of-sweep is indicated before sending the trigger message). The "TR1" data message must have previously been sent to enable remote trigger operation.
- h. **SERVICE REQUEST:** When in remote operation, the 5344S sends the SERVICE REQUEST message to the controller under the following conditions:
  1. The 5344S is in Lock mode, but the input signal is not locked, and the OUT OF LOCK bit has been set in the SRQ mask register (see "RM" data message). Note that OUT OF LOCK does not generate the SERVICE REQUEST message in LOCK/ROLL mode during the actual sweep. It is only significant during the locked portion of the LOCK/ROLL sequence).
  2. The 5344S is in a sweep mode (CF/ $\Delta$ F, START/STOP, LOCK/ROLL), the end of the sweep is detected, and the END OF SWEEP bit has been set in the SRQ mask register (see "RM" data message). Note that if the "TR1" data message has not been sent to the 5344S, the SERVICE REQUEST message will be cleared as soon as the next sweep begins.

#### NOTE

If the 5344S Single Sweep mode is enabled at the time the REMOTE message is received on the bus, the 5344S will act as if it has also received a "TR1" data message. If the "TR1" data message is in effect when the 5344S returns to local operation, the Single Sweep mode will be enabled.

- i. **STATUS: BYTE** The controller can read the 5344A STATUS BYTE at any time that the 5344A is in REMOTE operation to check selected operating conditions. This is especially useful in conjunction with the SERVICE REQUEST message. The controller can determine which event caused the service request. The bits of the STATUS BYTE have the following meanings:

7	6	5	4	3	2	1	0
—	RQS	EOS	OOL	FHI	FLO	—	LOK

- RQS = 1 — 5344S is sending a REQUEST SERVICE message.
- EOS = 1 — END OF SWEEP detected.
- OOL = 1 — OUT OF LOCK in LOCK mode.

#### NOTE

Bit 4 (Out of Lock) does not indicate error messages (see paragraph 3-119). Bit 4 (OOL) is also not valid until a period equal to the Lock time (see Table 1-1) after the Lock command (LK1) has been received.

- FHI = 1 — Input frequency too HIGH.
- FLO = 1 — Input frequency too LOW or insufficient signal level at counter input.
- LOK = 1 — 5344S is currently in LOCK mode, but not necessarily Locked (i.e., LK1 has been received).



#### NOTE

When LOK = 0, RQS = EOS = OOL = FHI = FLO = 0.

- j. **STATUS BIT:** NOT USED
- k. **PASS CONTROL:** NOT USED

### 3-151. Address Selection

3-152. To use the 5344S in an HP-IB system, you must set the rear panel ADDRESS switches to the desired address. The topmost switch sets the 5344S to either the ADDRESSABLE or the SYSTEM CONTROLLER mode. For use with a controller, the switch must be set to the ADDRESSABLE position. SYSTEM CONTROLLER is used when the 5344S is controlling an HP-IB programmable sweeper such as the HP 8350A. See System Controller Mode, paragraph 3-177 for more details.

3-153. The five bottom switches, A1 through A5, set the LISTEN/TALK addresses of the 5344S. Table 3-13 shows all possible address settings of the corresponding ASCII codes for talk and listen. The 5344S is factory set to address 4 as shown in Figure 3-19.

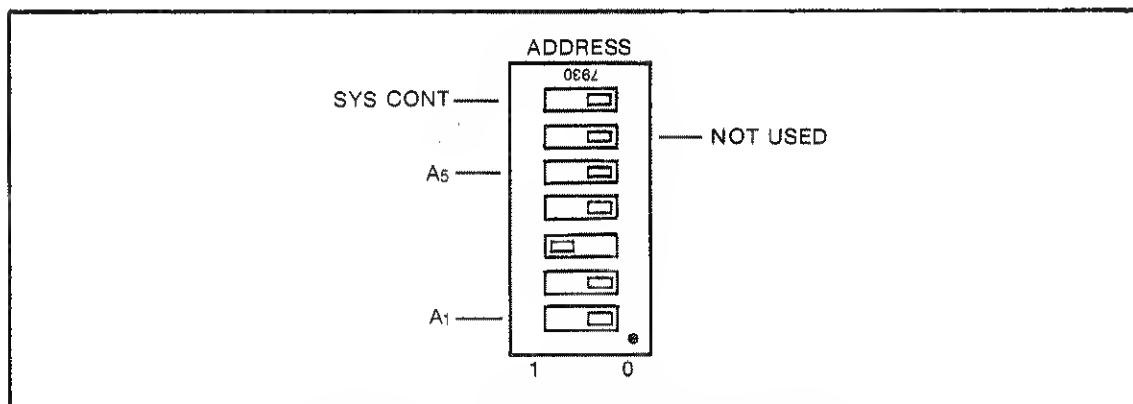


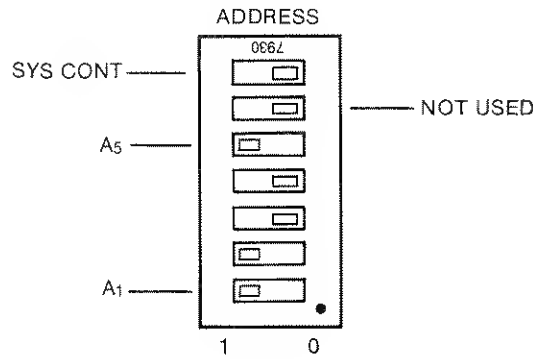
Figure 3-19. 5344S Address Switches Set to Address 4

3-154. Whenever you change the HP-IB address of the 5344A, turn the 5344A OFF, and then ON again.

### 3-155. Front Panel HP-IB Annunciators

3-156. The four HP-IB annunciators on the front panel indicate the status of the 5344S. The RMT annunciator lights to indicate that the 5344S is under remote control. The LSN annunciator indicates that the 5344S has been addressed to listen (receive commands.) The TALK annunciator indicates that the 5344S is addressed to talk. The CONT annunciator lights to indicate that the 5344S is in the System Controller mode (rear panel switch set to SYS CONT.).

Table 3-13. Address Selection



Address 19 Shown

**NOTE**

Select the listen address from the table below and set the address switches to the corresponding positions.

ASCII CODE CHARACTER	ADDRESS SWITCHES					5-BIT DECIMAL CODE
	A5	A4	A3	A2	A1	
SP	0	0	0	0	0	00
!	0	0	0	0	1	01
"	0	0	0	1	0	02
#	0	0	0	1	1	03
\$	0	0	1	0	0	04
%	0	0	1	0	1	05
&	0	0	1	1	0	06
'	0	0	1	1	1	07
(	0	1	0	0	0	08
)	0	1	0	0	1	09
*	0	1	0	1	0	10
+	0	1	0	1	1	11
,	0	1	1	0	0	12
-	0	1	1	0	1	13
.	0	1	1	1	0	14
/	0	1	1	1	1	15
0	1	0	0	0	0	16
1	1	0	0	0	1	17
2	1	0	0	1	0	18
3	1	0	0	1	1	19
4	1	0	1	0	0	20
5	1	0	1	0	1	21
6	1	0	1	1	0	22
7	1	0	1	1	1	23
8	1	1	0	0	0	24
9	1	1	0	0	1	25
:	1	1	0	1	0	26
;	1	1	0	1	1	27
<	1	1	1	0	0	28
=	1	1	1	0	1	29
>	1	1	1	1	0	30

Address "21" is preset calculator address and cannot be used.



### 3-157. COMMAND CODES

3-158. All local functions are programmable via the HP-IB. All functions operate essentially the same as in local. The command codes described in the following paragraphs are listed in a condensed version in Table 3-15.

### 3-159. HP-IB Command Code Syntax Diagrams

3-160. Statement syntax is represented pictorially in the following paragraphs, to explain the format in which HP-IB programming commands should be sent to the instrument. All characters enclosed by a rounded envelope must be entered exactly as shown. Words enclosed by a rectangular box are names of items used in the statement and are described in the text following the diagram. Items contained within circles indicate required literals which must occur in the statement syntax exactly as shown.

#### NOTE

Spaces are not included in all instances where they may occur.  
Rather, they are included as (optional) additions to the command string in places where clarity is gained by their use.

3-161. Statement elements, connected by lines, can be followed in only one direction as indicated by the arrowhead at the end of the line. Any combination of statement elements that can be generated by following the lines in the proper direction is syntactically correct.

## COMMAND CODES

### INSTRUMENT PRESET

#### IP

Sets the 5344S to its power-up conditions as follows:



#### LOCAL

MODE = CW, CW Frequency = 0

MARKERS 1 through 4 = OFF, all Marker Frequencies = 0

SWEEP TIME = 10 ms

STEP SIZE = 0

FREQUENCY MULTIPLIER = 1

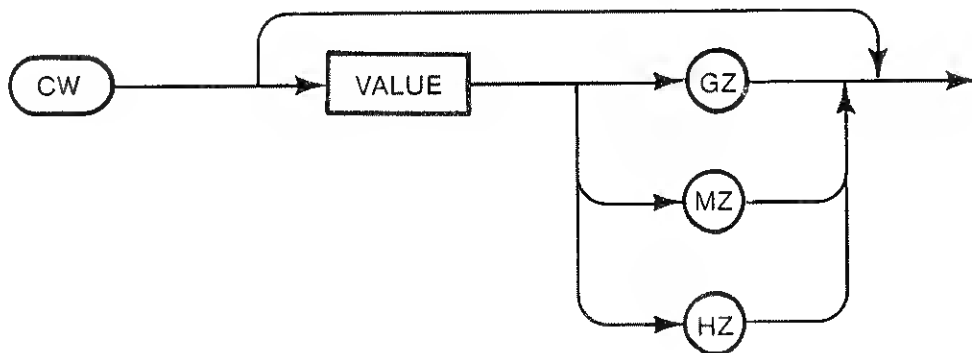
RM = 0

The IP command must not be followed by any other commands or data including carriage returns or line feeds until the power-up reset is complete. These commands will be ignored. The IP command should be placed on its own line.

### CONTINUOUS WAVE

#### CW

Sets the 5344S to CW mode. The 5344S enters and displays the CW frequency.



#### VALUE:

The value may be a simple number such as 10, 25.98, 1010.25, etc. The value may also be a simple number plus an exponent, such as 10.79 E+9, 10 E-1, 26.5 E-2, etc. The exponent plus the multiplier must fall within the 5344S range, such as 75.92 E-1 GZ = 7.592 GHz.

Only the first 11 digits are significant. All others are ignored. Only the first decimal point is accepted as valid.

The CW frequency range is 500 MHz to 18 GHz for the 5342A and 500 MHz to 26.5 GHz for the 5343A. If the 5344S is placed in Subharmonic Locking mode, the limit extends from 10 MHz to 99.99999999 GHz for both counters.

Entries outside of the limits default to the closest limit.

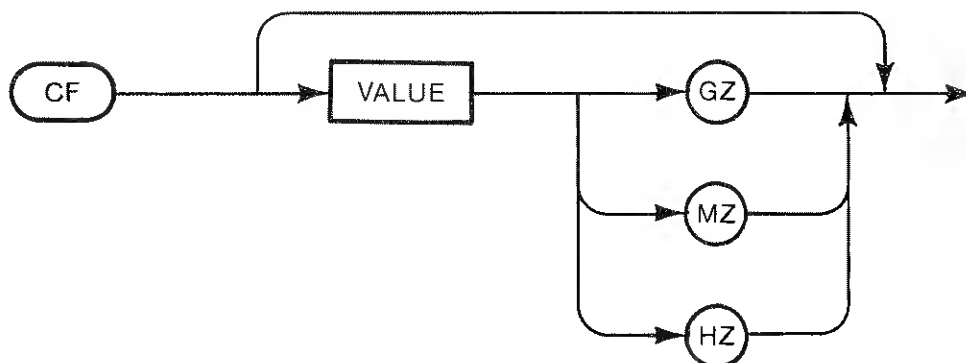


## COMMAND CODES (Continued)

### CENTER FREQUENCY

#### CF

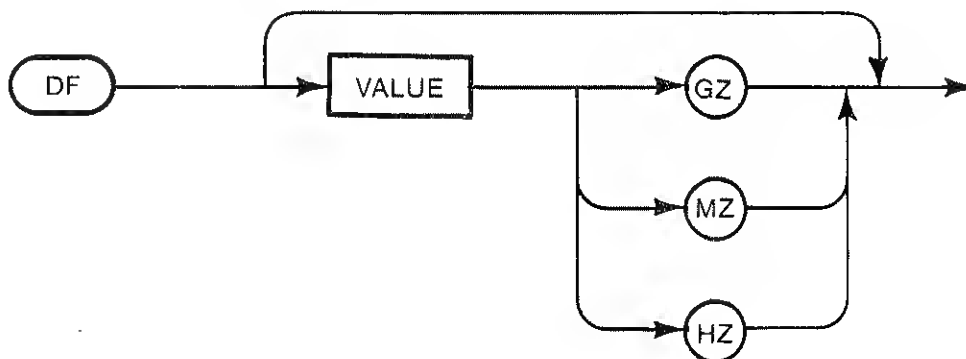
Sets the 5344S to CF/DF mode. The 5344A enters and displays the CF frequency.



### DELTA FREQUENCY

#### DF

Sets the 5344S to CF/ $\Delta$ F mode. The 5344A enters and displays the  $\Delta$ F frequency.



#### VALUE:

The value for CF and DF may be a simple number such as 10, 25.98, 1010.25, etc. The value may also be a simple number plus an exponent, such as 10.79 E+9, 10 E-1, 26.5 E-2, etc. The exponent plus the multiplier must fall within the 5344S range, such as 75.92 E-1 GZ = 7.592 GHz.

The CF frequency range is 500 MHz to 18 GHz for the 5342A and 500 MHz to 26.5 GHz for the 5343A. If the 5344S is placed in Subharmonic Locking mode, the limit extends from 10 MHz to 99.99999999 GHz for both counters.

The DF frequency range is 0 MHz to 40 MHz. If the 5344S is placed in Subharmonic Locking mode, the limits remain 0 MHz to 40 MHz for both counters.

Only the first 11 digits are significant. All others are ignored. Only the first decimal point is accepted as valid.

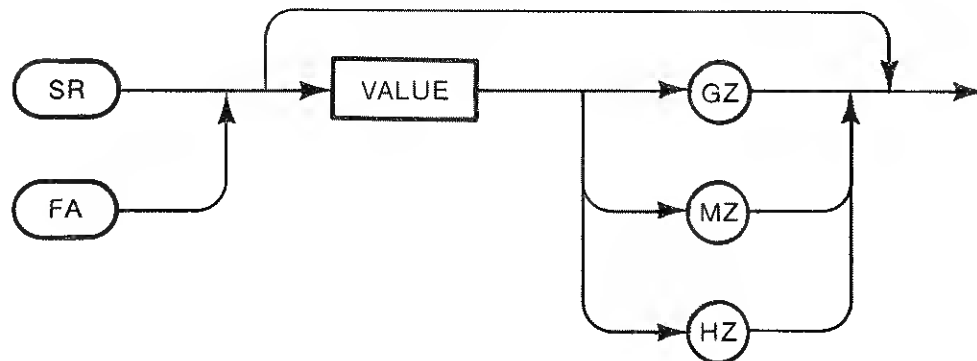
The CF and DF commands may be used together in one single command string or placed on separate lines. The 5344S will enter the CF/DF mode upon receipt of either CF or DF. Either command may be changed without affecting the unspecified commands. Sending any one of the commands without numerical values causes the 5344A to display that parameter. The parameter remains unchanged.

## COMMAND CODES (Continued)

### START

#### SR (FA)

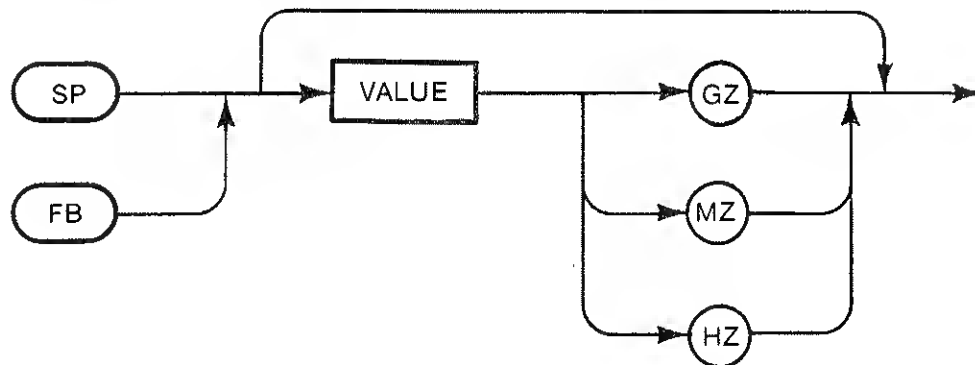
Sets the 5344S to START/STOP mode. The 5344A enters and displays the START frequency. SR and FA are identical. FA is provided for conversion of 8350A programs.



### STOP

#### SP (FB)

Sets the 5344S START/STOP mode. The 5344S enters and displays the STOP frequency. SP and FB are identical. FB is provided for conversion of 8350A programs.



### VALUE:

The value for START and STOP may be a simple number such as 10, 25.98, 1010.25, etc. The value may also be a simple number plus an exponent, such as 10.79 E+9, 10 E-1, 26.5 E-2, etc. An exponent plus a multiplier must fall within the 5344S range, such as 75.92 E-1 GZ = 7.592 GHz.

The START and STOP frequency range is 500 MHz to 18 GHz for the 5342A and 500 MHz to 26.5 GHz for the 5343A. If the 5344S is placed in Subharmonic Locking mode, the limit extends from 10 MHz to 99.99999999 GHz for both counters.

Only the first 11 digits are significant. All others are ignored. Only the first decimal point is accepted as valid.

The SR (FA) and SP (FB) commands may be used together in one single command string or placed on separate lines. The 5344S will enter the START/STOP mode upon receipt of either SR (FA) or SP (FB). Either command may be changed without affecting the unspecified commands. Sending any one of the commands without numerical values causes the 5344A to display that parameter. The parameter remains unchanged.

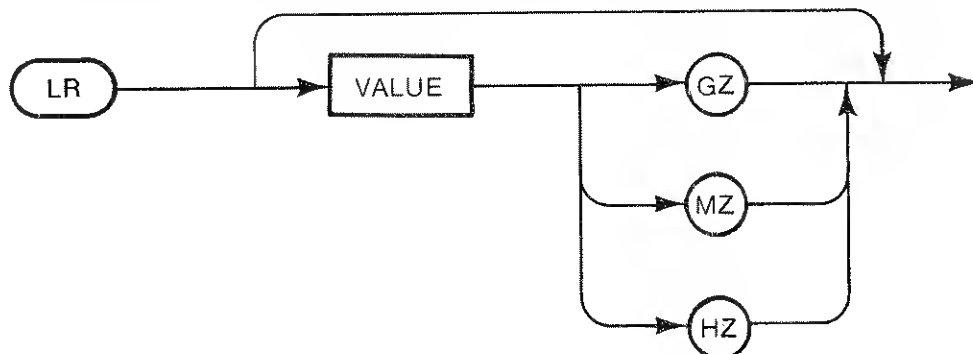


## COMMAND CODES (Continued)

### LOCK/ROLL

#### LR

Sets the 5344S to LOCK/ROLL mode. The 5344A enters and displays LK/R START frequency. The STOP frequency and Sweep time are set on the sweep oscillator.



#### VALUE:

The value for LR may be a simple number such as 10, 25.98, 1010.25, etc. The value may also be a simple number plus an exponent, such as 10.79 E+9, 10 E-1, 26.5 E-2, etc. The exponent plus the multiplier must fall within the 5344S range, such as 75.92 E-1 GZ = 7.592 GHz.

The LR frequency range is 500 MHz to 18 GHz for the 5342A and 500 MHz to 26.5 GHz for the 5343A. If the 5344S is placed in Subharmonic Locking mode, the limit extends from 10 MHz to 99.999999999 GHz for both counters.

Only the first 11 digits are significant. All others are ignored. Only the first decimal point is accepted as valid.

Sending the LR command without a numerical values causes the 5344A to display that parameter. The parameter remains unchanged.

Entries outside of the limits default to the closest limit.



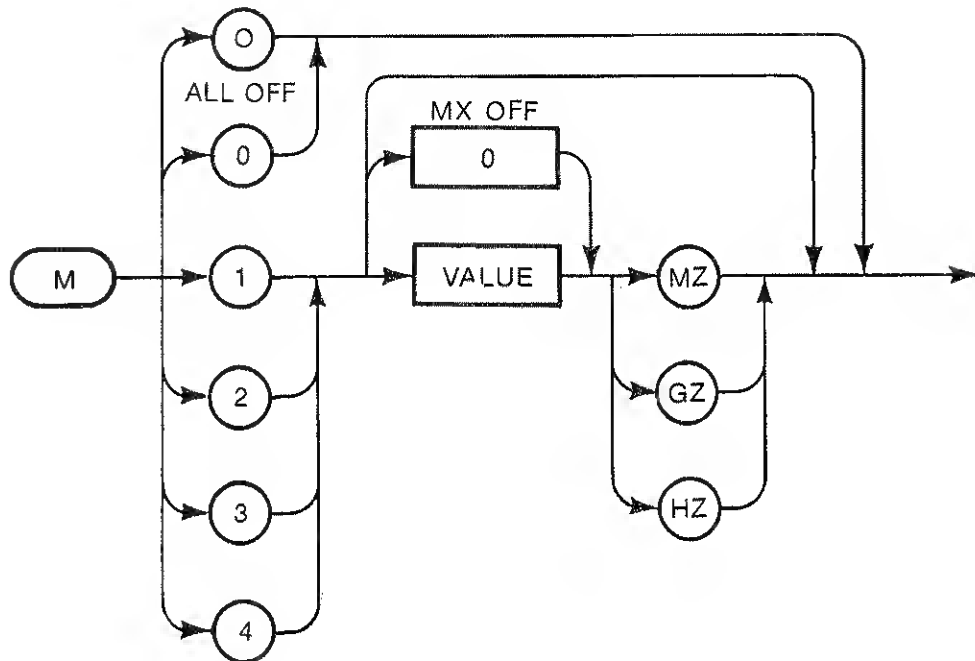
## COMMAND CODES (Continued)

### MARKERS

#### M0-M4

- M0 or MO Turns off all markers.  
M1 The 5344A enters and displays MARKER 1 frequency.  
M2 The 5344A enters and displays MARKER 2 frequency.  
M3 The 5344A enters and displays MARKER 3 frequency.  
M4 The 5344A enters and displays MARKER 4 frequency.

Setting any marker frequency to 0 turns OFF only that marker.



#### VALUE:

The value for MARKERS may be a simple number such as 10, 25.98, 1010.25, etc. The value may also be a simple number plus an exponent, such as 10.79 E+9, 10 E-1, 26.5 E-2, etc. An exponent plus a multiplier must fall within the 5344S range, such as 75.92 E-1 GZ = 7.592 GHz.

The MARKER frequency range is 500 MHz to 18 GHz for the 5342A and 500 MHz to 26.5 GHz for the 5343A. If the 5344S is placed in Subharmonic Locking mode, the limit extends from 10 MHz to 99.999999999 GHz for both counters.

Only the first 11 digits are significant. All others are ignored. Only the first decimal point is accepted as valid.

Sending any one of the commands without numerical values causes the 5344A to display that marker frequency. The marker frequency remains unchanged.

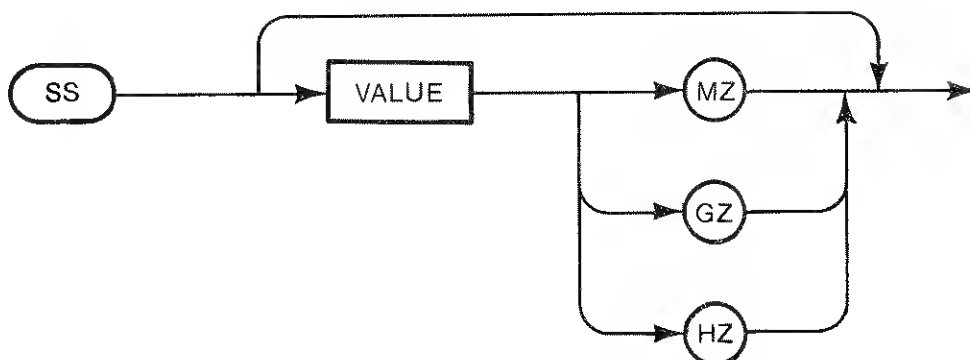


## COMMAND CODES (Continued)

### STEP SIZE

#### SS

The 5344A enters and displays the STEP SIZE frequency.



#### VALUE:

The value for SS may be a simple number such as 10, 25.98, 1010.25, etc. The value may also be a simple number plus an exponent, such as 10.79 E+9, 10 E-1, 26.5 E-2, etc. The exponent plus the multiplier must fall within the 5344S range, such as 75.92 E-1 GZ = 7.592 GHz.

The SS frequency range is 500 MHz to 18 GHz for the 5342A and 500 MHz to 26.5 GHz for the 5343A. If the 5344S is placed in Subharmonic Locking mode, the limit extends from 10 MHz to 99.99999999 GHz for both counters.

Only the first 11 digits are significant. All others are ignored. Only the first decimal point is accepted as valid.

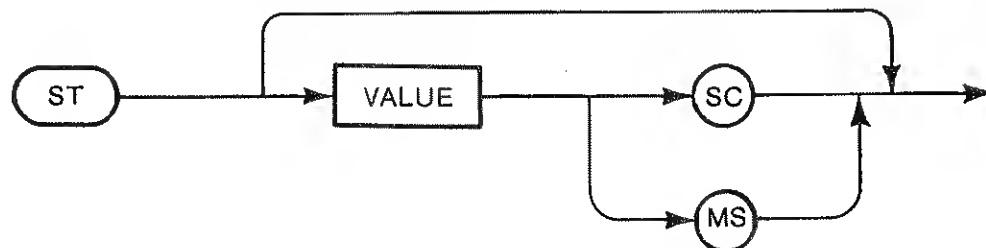
Sending the SS command without a numerical value causes the 5344A to display the current Step Size. The Step Size remains unchanged.

Entries outside of the limits default to the closest limit.

### SWEEP TIME

#### ST

The 5344S enters and displays the Sweep Time.



#### VALUE:

The value for ST may be a simple number such as 10, 25.9, .101, etc. The value may also be a simple number plus an exponent, such as 9.79 E+1, 10 E-1, 26.5 E-2, etc. A exponent plus a multiplier must fall within the 5344S range, such as 990 E-1 ms = 99 ms.

For any entry, the ultimate value for Sweep Time will contain only one digit after the decimal point. Consecutive digits are not rounded, but instead are dropped.

The Sweep Time range is 10 ms to 100 s.

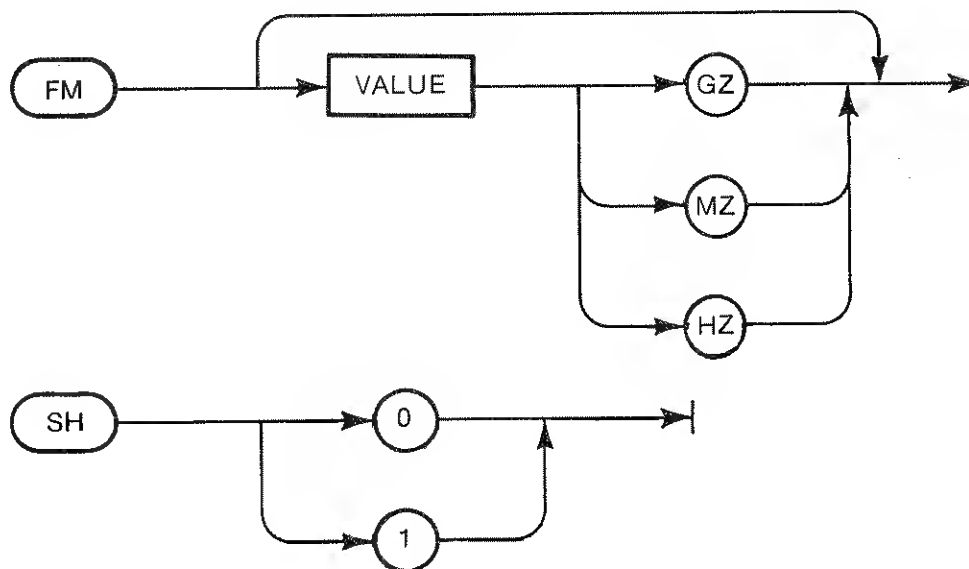
Entries outside of the limits default to the closest limit.

## COMMAND CODES (Continued)

### FREQUENCY MULTIPLIER

#### FM

The 5344S enters and displays the Frequency Multiplier.



#### VALUE:

The Frequency Multiplier can have a value of 1 to 99. If the FM is set to a value of 1, the 5344S can automatically determine the FM if it falls in the range of 1 to 4. An error will be displayed on the 5344A if the FM is determined to be greater than 4. If this occurs, the FM must be manually calculated and entered with the FM command.

Sending the command M9 (Marker 9) will not select FM.

The Subharmonic Mode command (SH1) must be sent to allow the use of Frequency Multipliers.

### ACQUIRE

#### AQ



The AQ command causes the 5344S to enter and display the current frequency being counted by the counter. The 5344S will enter this frequency into the various modes as follows:

- If CW is selected, the AQ frequency becomes the CW value.
- If CF/ $\Delta$ F is selected, only the CF can be acquired.
- In START/STOP, if:
  - START (SR or FA) is selected, the AQ frequency becomes the Start value.
  - STOP (SP or FB) is selected, the AQ frequency becomes the Stop value.
- If Lock/Roll (LR) is selected, the AQ frequency becomes the Lock/Roll Start value.

### UP/DN Increment/Decrement





## COMMAND CODES (Continued)

### UP

Increments the currently selected frequency parameter by the current Step Size (SS).

### DN

Decrements the currently selected frequency parameter by the current Step Size (SS).

The UP and DN commands may only be used to change frequency parameters including the Markers.

The 5344S will ignore any attempt to increment a time parameter such as Sweep Time.

To increment a parameter not currently selected, specify the parameter followed by the UP or DN command, such as:

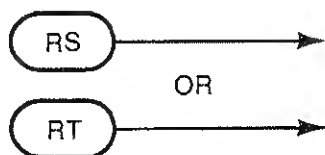
CWUP	CFDN
DFUP	FBDN
FAUP	SPDN
SRUP	LRDN
	M4DN

When incrementing the different parameters, there is a possibility of incrementing beyond the S344S lock range. If this occurs the S344A will display Err 01, and if the RM1 command is used a Service Request will be generated. The signal source must be tuned manually or over the HP-IB to within the S344S lock range.

### RESET

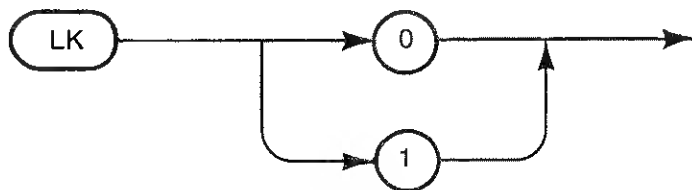
#### RS (RT)

Restarts the locking algorithm. RS will not return the 5344S to local. RT is the same as RS.



### MANUAL LOCK

#### LK 1/0



Sets Manual Lock ON or OFF. The LK command may be part of a command string or placed on a separate line.

Sending the LK 1 command does not guarantee the 5344S will lock. LK1 tells the S344S to make an attempt to lock. If the signal source is within the lock range, Lock will be achieved. If not, the S344A will light the FREQ HI or FREQ LO annunciator. The signal source must be tuned manually or over the HP-IB if possible.

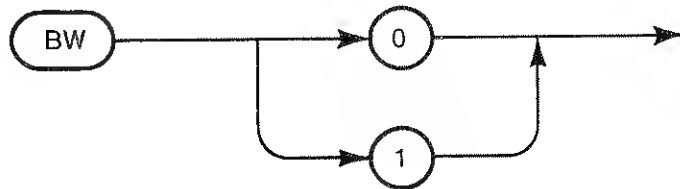
Auto Lock cannot be remotely programmed.

## COMMAND CODES (Continued)

### BANDWIDTH

BW 1/0

Set the 5344A to Wide or Narrow Bandwidth.



BW1 Sets Wide Bandwidth

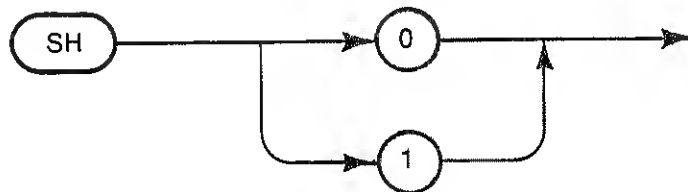
BW0 Sets Narrow Bandwidth

The Manual Lock light will flash when the Bandwidth is set to Narrow in Manual Lock.

### SUBHARMONIC LOCKING

SH 1/0

Set the 5344A to Subharmonic Mode.



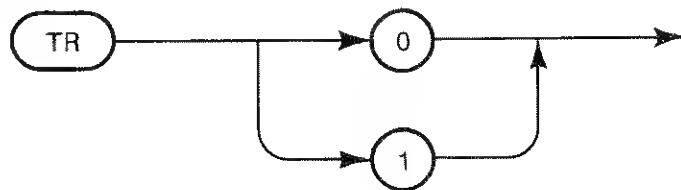
SH1 Sets Subharmonic ON

SH0 Sets Subharmonic OFF

If frequency values beyond 18 GHz (5342A) or 26.5 GHz (5343A) are to be used, the Subharmonic command must be sent before any mode command, such as:

SH1CW20GZ      SH1CF30GZ

### SWEEP TRIGGER



TR 1/0

Selects either Remote or Internal Sweep Trigger.

**TR1** Selects Remote Trigger. TR1 does not initiate a sweep. The TS command must be used to trigger a sweep. TR1 tells the 5344S to sweep when a TS command is received.

**TR0** Selects Internal Sweep Trigger. 5344S will trigger approximately 10 ms after completion of the last sweep.



## COMMAND CODES (Continued)

### TRIGGER SWEEP

#### TS



Initiates a Single Sweep. The TR1 message must have been previously sent, or must proceed the TS command in the command string.

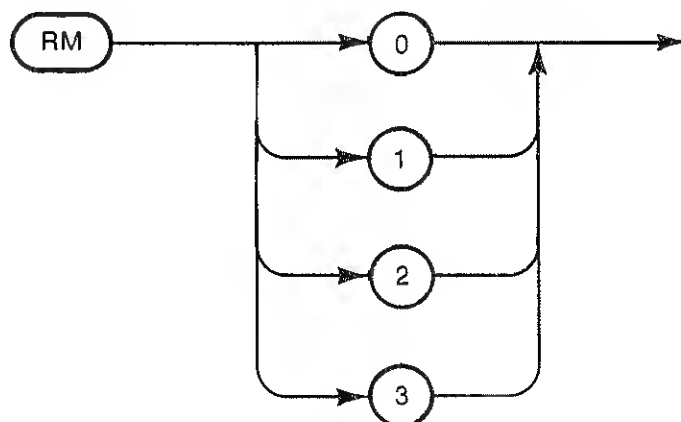
If the 5344S is in CW mode, sending the TS command is essentially the same as sending the Reset (RS) command. The 5344S will restart the locking process.

Group Execute Trigger (GET), such as the TRIGGER command (HP 85-Basic) may also be used to initiate a sweep. Refer to the specific controller's operating manual for more details.

### SERVICE REQUEST MASK

#### RM

Set the 5344A Service Request mask. The RM command determines which of the following conditions will generate a Service Request.



The RM command is followed by a single digit which specifies the set of conditions that is to generate a service request:

- 0 — NONE
- 1 — OUT OF LOCK
- 2 — END OF SWEEP
- 3 — OUT OF LOCK or END OF SWEEP

Only one condition may be active at any one time. If more than one is specified, such as RM12, the second value will be ignored. Notice however, that RM3 considers two conditions to generate an SRQ interrupt.

### 3-162. Input Code Format

3-163. The 5344A will accept command strings in either upper or lower case. Spaces, carriage returns, linefeeds and invalid message sequences are ignored. For example, (in HP 85A-Basic):

OUTPUT 701; "CW2GZLK1" or output 701; "cw2gzlk1"



Either format will produce the same results. Depending on the controller, this can help speed programming.

3-164. Parameter data messages (CW, CF, DF, SR, SP, LR, M1, M2, M3, M4, SS, 5T, FM) are usually, but not necessarily followed by a frequency. The parameter data message by itself results in the specified parameter being displayed on the front panel.

### 3-165. Special Programming Considerations

3-166. Only the first 11 digits of a simple number are significant. Others are ignored. Also, only the first decimal point has any effect.

3-167. Only the first 2 digits of an exponent are significant. Others are ignored.

3-168. The FM parameter may be terminated with any frequency units data message (GZ, MZ, HZ).

### 3-169. Output Format

3-170. The 5344A does not have the capability to output data. The 5344A can only output status information as described in paragraph 3-150.

### 3-171. Remote Frequency Offset Locking

3-172. To fully understand Frequency Offset Locking during remote, a few points should be discussed.

3-173. First, the 5344A and the counter cannot be in Remote at the same time. The 5344A needs the counter's circuitry to perform its functions. To avoid any conflict, whenever the 5344A is placed into Remote and Lock in ON, the counter is automatically switched to Local and the front panel controls are locked out.

3-174. In Frequency Offset Locking, the counter must have a frequency offset activated. The counter always adds the offset to the frequency being counted. For Frequency Offset Locking the offset value is entered as negative, such as -3.8 GHz. This can be done over the HP-IB (provided the counter has HP-IB) using the following command string:

SOM-3800EOM1     See the appropriate counter manual for specific details.

3-175. Both the 5342A and 5343A Microwave Counters will retain any offset entered when they return to Local. This is necessary, so when the 5344A is set to Remote, the counter will still have the offset active. This allows the 5344S System to operate completely under remote control.

3-176. To summarize, the following is the basic procedure for remote operation of Frequency Offset Locking.

- Set both the counter and 5344A to Local.
- Place the counter into Remote. Send the code string to enter the required frequency offset. For example, if -3.8 GHz must be subtracted, the code string SOM -3800EOM1 would be sent.
- Place the 5344A into Remote and send the desired commands. When the 5344A goes Remote, the counter will automatically go to Local. The frequency offset will still be active in the counter. Remember to send the SH1 command (activate Subharmonic mode).



### 3-177. SYSTEM CONTROLLER MODE (AUTO LOCK)

3-178. In the Auto Lock mode, there is no calculator or computer controlling the HP-IB. Instead, the 5344A is placed in the System Controller mode by setting the rear panel ADDRESS switch to the SYS CONT position. The 5344A HP-IB connector is connected directly to the HP-IB connector of the 8350A or 8620C Option 011 Sweep Oscillator. No other powered-up controllers may be connected to the bus.

3-179. The 5344A now has the ability to program the sweep parameters based on data entered on the 5344A keyboard. For instance, 2 GHz is entered into the 5344A keyboard in the CW Mode. When the AUTO LOCK key is pressed, the 5344A will program the sweeper to 2 GHz. Provided the sweeper is properly aligned, the actual output frequency should be within the 5344S lock range. If the actual frequency is not within the lock range, the 5344A will alter the bus code in an attempt to bring the sweeper within lock range. If the 5344A is unsuccessful, Err 11 will be displayed on the 5344A.

3-180. The address of the 5344A and the sweeper must be set to the same value.

3-181. The 5344S cannot be operated in Auto Lock/Roll with an 8620 series sweeper.

3-182. For HP-IB interface capability in System Controller Mode, see Table 3-14.

SH1, AH1, T4, L2, SR0, RL0, PP0, DC0, DT0, C1, 2, 3, 4, 27, E1

Table 3-14. HP-IB Interface Functions (System Controller Mode)

Interface Function Subset Identifier	Interface Function Description
SH1	Complete Source Handshake Capability
AH1	Complete Acceptor Handshake Capability
T4	Talker - (Basic Talker, No Serial Poll, No Talk Only, Doesn't Unaddress If MLA)
L2	Listener - (Basic Listener, No Listen Only, Doesn't Unaddress to Listen If MTA)
SR0	No Service Request Capability
RL0	No Complete Remote/Local Capability
PP0	No Parallel Poll Capability
DC0	No Complete Device Clear Capability
DT0	No Device Trigger Capability
C1	System Controller Capability
C2	Send IFC and Take Charge
C3	Send REN
C4	Responds to SRQ
C27	Send Interface Message, Cannot Receive Control, Cannot Pass Control to Self, No Parallel Poll, Can Take Control Synchronously
E1	Open Collector Outputs

3-183. The 5344S acts as a system controller for an HP 8620C or HP 8350A sweeper. No other system controller may be on the bus. The 5344S HP-IB address switch must be set to the address of the sweeper, and the system controller switch must be in the SYS CONT. position.





### NOTE

The operating algorithm in this mode includes a measurement of output frequency with the HP 8620C programmed to its minimum and maximum frequency. The user must ensure that the sweeper output power and cabling to the 5342A/43A counter will deliver a sufficient signal level. For example, the user may wish to lock at 2 GHz using an 86290 plug-in and cables adequate for 2 GHz but not 18 GHz. When the automatic locking algorithm in the 5344S sets the sweeper to 18 GHz for calibration, Err 01 will result.

Table 3-15. Condensed HP-IB Command Code Set

IP	Instrument Preset Set the 5344S to the following conditions: Local Mode = CW, Frequency = 0 All Markers Off Sweep Time = 10 mS Step Size = 0 Frequency Multiplier = 1 RM = 0
CW	Sets 5344S to CW mode. Enters and displays CW frequency.
CF	Sets 5344S to CF/ $\Delta$ F mode. Enters and displays CF frequency.
DF	Sets 5344S to CF/ $\Delta$ F mode. Enters and displays $\Delta$ F frequency.
SR	Sets 5344S to Start/Stop mode. Enters and displays Start frequency.
FA	Sets 5344S to Start/Stop mode. Enters and displays Start frequency.
SP	Sets 5344S to Start/Stop mode. Enters and displays Stop frequency.
FB	Sets 5344S to Start/Stop mode. Enters and displays Stop frequency.
LR	Sets 5344S to Lock/Roll mode. Enters and displays Start frequency.
M0	Turns all Markers OFF.
MO	Turns all Markers OFF.
M1	Selects Marker 1. Enters and displays Marker 1.
M2	Selects Marker 2. Enters and displays Marker 2.
M3	Selects Marker 3. Enters and displays Marker 3.
M4	Selects Marker 4. Enters and displays Marker 4. Setting Marker N to 0 turns off Marker N.
SS	Selects Step Size. Enters and displays Step Size.
ST	Selects Sweep Time. Enters and displays Sweep Time.
FM 1	5344S automatically determines Frequency Multiplier.
FM N	Enters Frequency Multiplier    1 < N < 99
AQ	5344S acquires current frequency value for current mode.
UP	Increments current frequency mode by current Step Size.
DN	Decrements current frequency mode by current Step Size.
RS	Restarts locking process.
RT	Restarts locking process.



Table 3-15. Condensed HP-IB Command Code Set (Continued)

LK0	Manual Lock is turned OFF.
LK1	Manual Lock is turned ON.
BW0	Bandwidth is set Narrow.
BW1	Bandwidth is set Wide.
SH0	Subharmonic mode is turned OFF.
SH1	Subharmonic mode is turned ON. SH1 must precede frequency values greater than 18 GHz (5342A) or 26.5 GHz (5343A).
TR0	Sets 5344S to internal sweep trigger.
TR1	Sets 5344S to remote sweep trigger.
TS1	Triggers a sweep. TR1 must be active to use TS1.
RM0	5344S will not generate a Service Request.
RM1	5344S generates a Service Request when Out Of Lock. LK1 must be active for RM1 to generate a Service Request.
RM2	5344S generates a Service Request when at End Of Sweep.
RM3	5344S generates a Service Request when Out Of Lock or at End of Sweep. LK1 must be active for RM3 to generate a Service Request when Out Of Lock.



